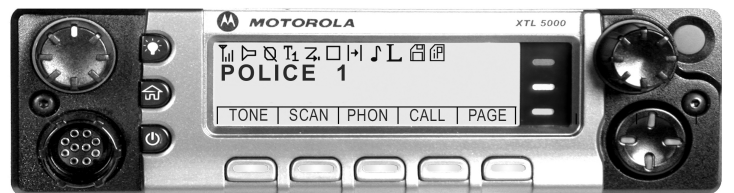
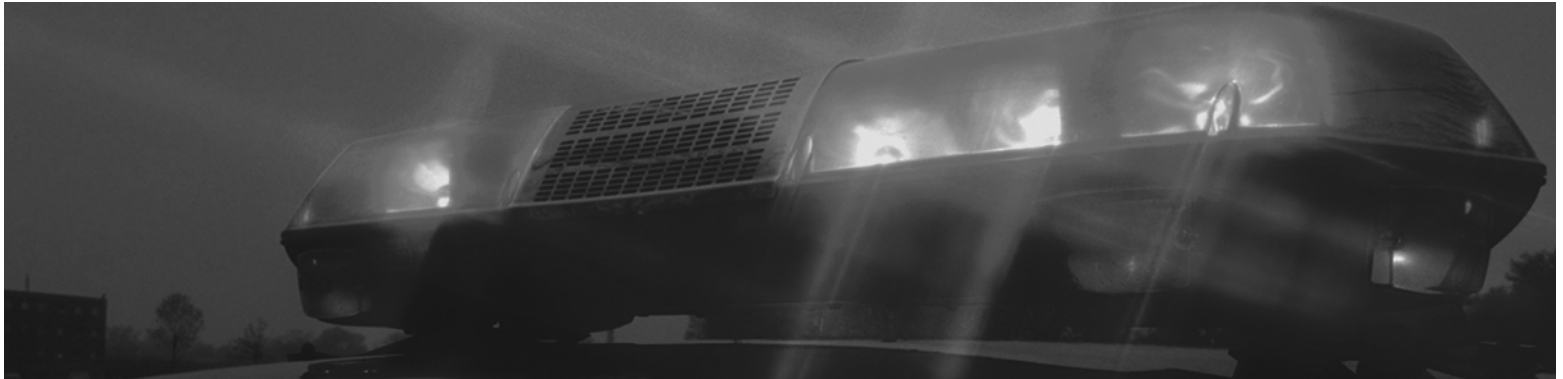


# ASTRO<sup>®</sup> XTL<sup>™</sup> 5000

Digital Mobile Radio

O3 / O5 Control Head

*Basic Service Manual*





**ASTRO® Digital XTL™ 5000**  
**VHF/UHF Range 1/UHF Range 2/**  
**700–800 MHz**  
**Mobile Radio**  
**Basic Service Manual**



# Foreword

This manual covers all models of the ASTRO® Digital XTL™ 5000 VHF/UHF Range 1/UHF Range 2/700–800 MHz Mobile Radio, unless otherwise specified. It includes all the information necessary to maintain peak product performance and maximum working time, using levels 1 and 2 maintenance procedures. This level of service goes down to the board replacement level and is typical of some local service centers, self-maintained customers, and distributors.

For details on radio operation or component-level troubleshooting, refer to the applicable manuals available separately. A list of related publications is provided in the section, “[Related Publications](#),” on page xvi.

## Product Safety and RF Exposure Compliance



**Before using this product, read the operating instructions for safe usage contained in the Product Safety and RF Exposure booklet enclosed with your radio.**

### ATTENTION!

**This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your radio (Motorola Publication part number 6881095C99) to ensure compliance with RF energy exposure limits.**

**For a list of Motorola-approved antennas, batteries, and other accessories, visit the following web site which lists approved accessories: <http://www.motorola.com/governmentandenterprise>.**

## Manual Revisions

Changes which occur after this manual is printed are described in PMRs (Publication Manual Revisions). These PMRs provide complete replacement pages for all added, changed, and deleted items. To obtain PMRs, go to <https://businessonline.motorola.com>.

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## Document History

The following major changes have been implemented in this manual since the previous edition:

Edition	Description	Date
6871769L01-A	Initial Release	Oct. 2006

## Notes

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## Related Publications

ASTRO Digital XTL 5000 Mobile Radio User's Guide .....	HLN6951_
ASTRO Digital XTL 5000 Mobile Radio Installation Manual .....	HLN6947_
ASTRO Digital XTL 5000 VHF/UHF Range 1/700-800 MHz Mobile Radio Detailed Service Manual .....	6871770L01
CPS Programming Installation Guide .....	6881095C44
KVL 3000 User's Manual .....	6881131E16

# Commercial Warranty

## Limited Warranty

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Product Accessories	One (1) Year

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- B. Defects or damage from misuse, accident, water, or neglect.
- C. Defects or damage from improper testing, operation, maintenance, installation, alteration, modification, or adjustment.
- D. Breakage or damage to antennas unless caused directly by defects in material workmanship.
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  - the damage or defect is caused by charging or using the battery in equipment or service other than the Product for which it is specified.
- H. Freight costs to the repair depot.
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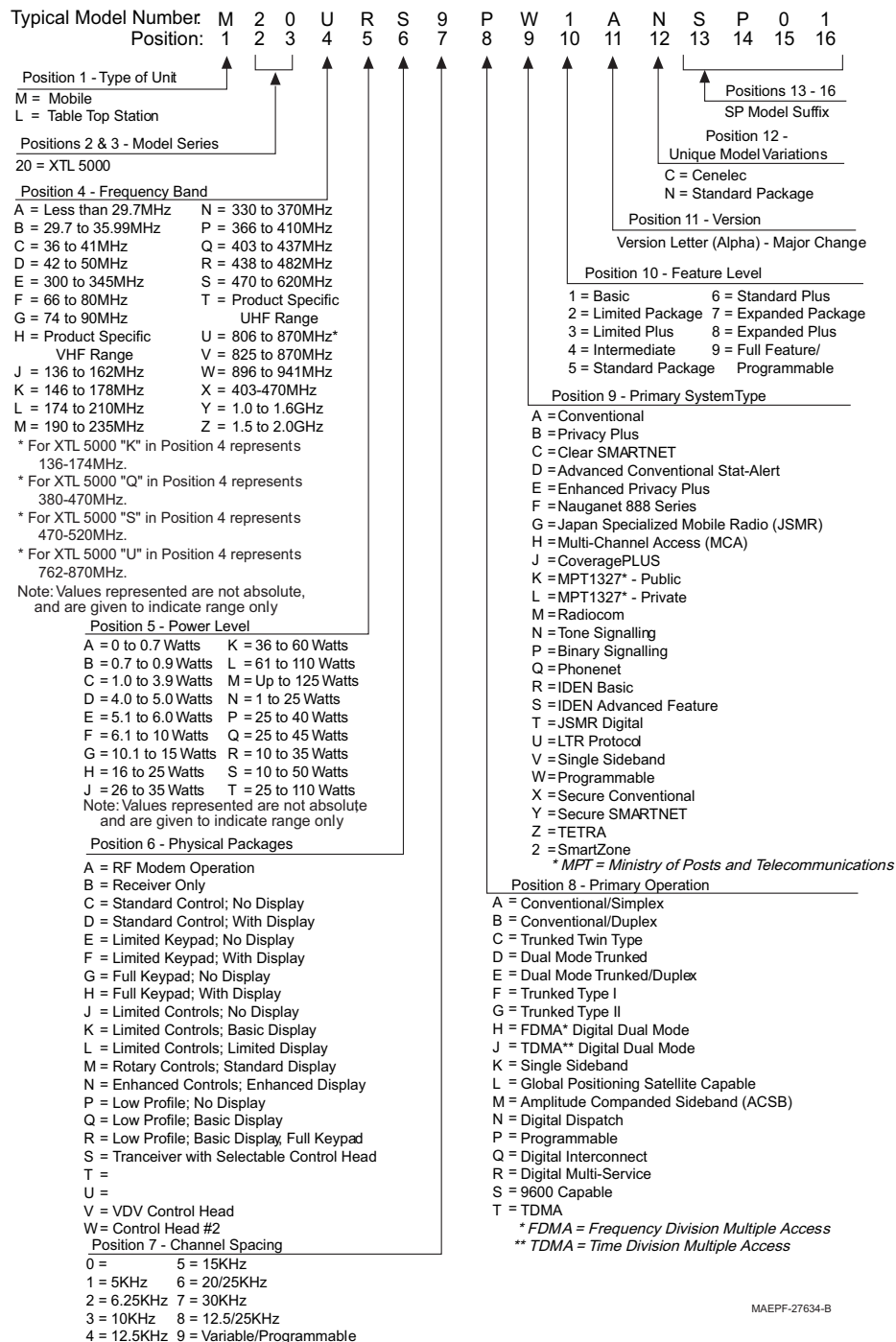
This Warranty is governed by the laws of the State of Illinois, USA.

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## Notes

# Model Numbering, Charts, and Specifications

## Mobile Radio Model Numbering Scheme



## ASTRO XTL 5000 O3 VHF 10-50 Watt Model Chart

M20KSS9PW1AN									
Option					Description				
				G66AH		ADD: Dash Mount Mid Power O3			
				G67AZ		ADD: Remote Mount Mid Power O3			
				G67AY		ADD: Remote Mount High Power O3			
				G655AH		ADD: Quick Release Remote Mount O3 High Power			
				G72AC		ADD: XTL5000 O3 Control Head			
				G159AH		ADD: XTL Encryption UCM HW 30 Sec Key			
				G159AJ		ADD: XTL Encryption UCM HW 3 Day Sec Key Ret			
					Item No.		Description		
	X	X	X	X		0364332H02	M3 x 5 screw		
				X		0364583H01	Screw, M6 x 1, Hex Socket		
			X	X		3064658H04	High Power TIB Flex Kit		
	X	X	X	X		3285471E01	Seal Headbridge		
				X		5564610H02	Handle Assembly		
				X		5564957H01	Key Lock		
	X	X	X	X		5684275A05	Bag Air Plastic 10" x 10"		
	X	X				HKM4192B	Mobile Power CBL High Power 20'		
			X	X		HKM6110_	Cable, Power, 100W		
	X	X				HKM6190B	Mid Power TIB Flex Kit		
	X	X				HLN6861A	Hardware XTL 5000 Standard Install		
	X	X	X	X		HLN6863A	Accessory Connection XTL 5000		
				X		HLN6909_	Quick Release HiPower Trunnion		
			X			HLN6910_	Screw, HiPower Trunnion		
	X	X	X	X		HLN6954_	Cover, Dust, Kit		
		X	X	X		PMLN4958A	O3 CAN 17' Extension Cable		
		X	X	X		PMLN4959A	O3 Accessory Cable		
				X		PMUN1034A	O3 Handheld Control Head		
	X	X	X	X		PMUN1036A	Remote Assy, Radio End with QuickDisconnect		
					X	HLN6919_	Secure Interface Board 30 Sec Key Retention		
					X	HLN6918_	Secure Interface Board 3 Day Key Retention		
					X	NNTN5032_	UCM II Mode		
X						HUD1793_	Tanapa VHF 50W		
					X	0310907A20	Screw M3 x 0.5 x 10		
					X	2685498E02	Shield		

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

**ASTRO XTL 5000 O3 VHF 10-50 Watt Model Chart (Cont.)**

M20KSS9PW1AN															
Option										Description					
G927AA										INT: Connector Remote Mount					
W874AA										ADD: Handset/Hangup Armored Cable (GCAI)					
G874AA										ADD: Handset/Hangup (GCAI)					
G876AA										ADD: Hangup/Cradle w/Coiled CBL, GCAI					
W872AA										ADD: Visor Mic Standard					
W22AW										ADD: STD Palm Mic GCAI					
G233AC										ADD: Gooseneck PTT Millennium					
W20BX										ALT: Keypad Microphone					
W382AH										ALT: Control Station Palm Microphone					
W665BE										ADD: Control Station Base Mount					
G91AB										ADD: Control Station Power Supply					
W688AP										ADD: External Emergency Pushbutton					
W81AL										ADD: Key Lock Mount					
W116AN										ADD: External Alarm and Relay Cable					
										Item No.		Description			
	X									HLN6961_	Accessory Connector Remote Mount				
		X								HKN1018_	Handset/Hangup Normal Armored Cable				
			X							HLN1457_	Handset/Hangup (Hangup Cup)				
				X						HKN1017_	Handset/Hangup Coiled Cable				
					X					HMN4089_	Visor Mic Remote Mount				
						X				HMN1090_	Std Palm Mic GCAI				
							X			HMN1087_	Gooseneck PTT				
								X		HMN4079_	Keypad Microphone				
									X	HMN1088_	Control Station Desk Microphone				
										HLN6042_	Control Station Mount				
										HPN4007_	Power Supply				
										HLN6188_	Emergency Pushbutton				
										HLN6372_	Keylock Mount				
										X	TLN4533_	Relays			
										X	HKN4258_	Cable Relay			
										X	HLN5131_	Emergency Button			
										X	HLN6047_	Hardware Installation Base Tray			
										X	6880101W87	Spectra Controller Station Instructor Manual			
										X	6880102W93	Spectra Maxtrac Controller Base Manual			

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

## ASTRO XTL 5000 O3 VHF 10-50 Watt Model Chart (Cont.)

M20KSS9PW1AN											
Option										Description	
W591AP										ADD: Auxiliary Switch Panel	
B18CL										ADD: Auxiliary Spkr Spectra 5 Watt	
W432AE										ADD: External 13 Watt Speaker	
G296AA										ADD: Antenna 1/4 Wave Whip Roof Top 136-144 MHz	
G297AA										ADD: Antenna 1/4 Wave Roof Top VHF 144-150.8 MHz	
G299AA										ADD: Antenna 1/4 Wave Roof Top VHF 150.8-162 MHz	
G300AA										ADD: Antenna 1/4 Wave Roof Top VHF 162-174 MHz	
G301AA										ADD: Antenna 3 dB Roof Top VHF 136-174 MHz	
W652AE										ADD: 1/4 Wave Broadband Antenna 136-162 MHz	
G629AA										ADD: 1/4 Wave Broadband Antenna 146-174 MHz	
G792AA										ADD: Wideband Antenna 136-174 MHz	
										Item No.	Description
X										HLN1196_	Auxiliary Switch Panel
	X									HSN4031_	External 7.5 Watt Speaker
		X								HSN4032_	External 13 Watt Speaker
			X							HAD4006_	1/4 Wave Whip Antenna Roof Top
				X						HAD4007_	1/4 Wave, Roof Top VHF
					X					HAD4008_	1/4 Wave Roof Top
						X				HAD4009_	1/4 Wave Roof Top
							X			HAD4016_	1/4 Wave Broadband Antenna 136-162 MHz
								X		HAD4017_	1/4 Wave Broadband Antenna 146-174 MHz
									X	HAD4021_	Wideband Antenna 136-174 MHz
						X				RAD4010ARB	3 dB Antenna 136-174 MHz

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

## ASTRO XTL 5000 O3 VHF 100 Watt Model Chart

M20KTS9PW1AN									
Option					Description				
				G66AH	ADD: Dash Mount Mid Power O3				
				G67AZ	ADD: Remote Mount Mid Power O3				
				G67AY	ADD: Remote Mount High Power O3				
				G655AH	ADD: Quick Release Remote Mount O3 High Power				
				G72AC	ADD: XTL5000 O3 Control Head				
					Item No.	Description			
	X	X	X	X	0364332H02	M3 x 5 screw			
				X	0364583H01	Screw, M6 x 1, Hex Socket			
			X	X	3064658H04	High Power TIB Flex Kit			
	X	X	X	X	3285471E01	Seal Headbridge			
				X	5564610H02	Handle Assembly			
				X	5564957H01	Key Lock			
	X	X	X	X	5684275A05	Bag Air Plastic 10" x 10"			
	X	X			HKN4192B	Mobile Power CBL High Power 20'			
			X	X	HKN6110_	Cable, Power, 100W			
	X	X			HKN6190B	Mid Power TIB Flex Kit			
	X	X			HLN6861A	Hardware XTL 5000 Standard Install			
	X	X	X	X	HLN6863A	Accessory Connection XTL 5000			
				X	HLN6909_	Quick Release HiPower Trunnion			
			X		HLN6910_	Screw, HiPower Trunnion			
	X	X	X	X	HLN6954_	Cover, Dust, Kit			
		X	X	X	PMLN4958A	O3 CAN 17' Extension Cable			
		X	X	X	PMLN4959A	O3 Accessory Cable			
				X	PMUN1034A	O3 Handheld Control Head			
	X	X	X	X	PMUN1036A	Remote Assy, Radio End with QuickDisconnect			
X					HUD1794_	Tanapa VHF 100W			

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)



## ASTRO XTL 5000 O3 VHF 100 Watt Model Chart (Cont.)

M20KTS9PW1AN									
Option								Description	
G159AH								ADD: XTL Encryption UCM HW 30 Sec Key	
G159AJ								ADD: XTL Encryption UCM HW 3 Day Sec Key Ret	
G927AA								INT: Connector Remote Mount	
W874AA								ADD: Handset/Hangup Armored Cable (GCAI)	
G874AA								ADD: Handset/Hangup (GCAI)	
G876AA								ADD: Hangup/Cradle w/Coiled CBL, GCAI	
W872AA								ADD: Visor Mic Standard	
W22AW								ADD: STD Palm Mic GCAI	
G233AC								ADD: Gooseneck PTT Millennium	
W20BX								ALT: Keypad Microphone	
W688AP								ADD: External Emergency Pushbutton	
								Item No.	Description
		X						HLN6961_	Accessory Connector Remote Mount
X								HLN6919_	Sec Interface Board 30 Sec Key Retention
	X							HLN6918_	Sec Interface Board 3 Day Key Retention
X	X							NNTN5032_	UCM II Mode
		X						HKN1018_	Handset/Hangup Normal Armored Cable
			X					HLN1457_	Handset/Hangup (Hangup Cup)
				X				HKN1017_	Handset/Hangup Coiled Cable
					X			HMN4089_	Visor Mic Remote Mount
						X		HMN1090_	Std Palm Mic GCAI
							X	HMN1087_	Gooseneck PTT
							X	HMN4079_	Keypad Microphone
							X	HLN6188_	Emergency Pushbutton
							X	HLN5131_	Emergency Button
X	X							0310907A20	Screw M3 x 0.5 x 10
X	X							2685498E02	Shield

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

**ASTRO XTL 5000 O3 VHF 100 Watt Model Chart (Cont.)**

M20KTS9PW1AN											
Option										Description	
W81AL										ADD: Key Lock Mount	
W116AN										ADD: External Alarm and Relay Cable	
W591AP										ADD: Auxiliary Switch Panel	
B18CL										ADD: Auxiliary Spkr Spectra 5 Watt	
W432AE										ADD: External 13 Watt Speaker	
G296AA										ADD: Antenna 1/4 Wave Whip Roof Top 136-144 MHz	
G297AA										ADD: Antenna 1/4 Wave Roof Top VHF 144-150.8 MHz	
G299AA										ADD: Antenna 1/4 Wave Roof Top VHF 150.8-162 MHz	
G300AA										ADD: Antenna 1/4 Wave Roof Top VHF 162-174 MHz	
G301AA										ADD: Antenna 3 dB Roof Top VHF 136-174 MHz	
W652AE										ADD: 1/4 Wave Broadband Antenna 136-162 MHz	
G629AA										ADD: 1/4 Wave Broadband Antenna 146-174 MHz	
G792AA										ADD: Wideband Antenna 136-174 MHz	
										Item No.	Description
X										HLN6372_	Keylock Mount
	X									TLN4533_	Relays
	X									HKN4258_	Cable Relay
		X								HLN1196_	Auxiliary Switch Panel
			X							HSN4031_	External 7.5 Watt Speaker
				X						HSN4032_	External 13 Watt Speaker
					X					HAD4006_	1/4 Wave Whip Antenna Roof Top
						X				HAD4007_	1/4 Wave, Roof Top VHF
							X			HAD4008_	1/4 Wave Roof Top
								X		HAD4009_	1/4 Wave Roof Top
									X	HAD4016_	1/4 Wave Broadband Antenna 136-162 MHz
									X	HAD4017_	1/4 Wave Broadband Antenna 146-174 MHz
									X	HAD4021_	Wideband Antenna 136-174 MHz
						X				RAD4010ARB	3 dB Antenna 136-174 MHz

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

## ASTRO XTL 5000 O3 UHF Range 1 10-40 Watt Model Chart

M20QSS9PW1AN									
Option					Description				
G66AH					ADD: Dash Mount Mid Power O3				
G67AZ					ADD: Remote Mount Mid Power O3				
G67AY					ADD: Remote Mount High Power O3				
G655AH					ADD: Quick Release Remote Mount O3 High Power				
G72AC					ADD: XTL5000 O3 Control Head				
G927AA					INT: Connector Remote Mount				
					Item No. Description				
X	X	X	X		0364332H02	M3 x 5 screw			
				X	0364583H01	Screw, M6 x 1, Hex Socket			
		X	X		3064658H04	High Power TIB Flex Kit			
X	X	X	X		3285471E01	Seal Headbridge			
				X	5564610H02	Handle Assembly			
				X	5564957H01	Key Lock			
X	X	X	X		5684275A05	Bag Air Plastic 10" x 10"			
X	X				HKN4192B	Mobile Power CBL High Power 20'			
		X	X		HKN6110_	Cable, Power, 100W			
X	X				HKN6190B	Mid Power TIB Flex Kit			
X	X				HLN6861A	Hardware XTL 5000 Standard Install			
X	X	X	X		HLN6863A	Accessory Connection XTL 5000			
				X	HLN6909_	Quick Release HiPower Trunnion			
		X			HLN6910_	Screw, HiPower Trunnion			
X	X	X	X		HLN6954_	Cover, Dust, Kit			
	X	X	X		PMLN4958A	O3 CAN 17' Extension Cable			
	X	X	X		PMLN4959A	O3 Accessory Cable			
				X	PMUN1034A	O3 Handheld Control Head			
X	X	X	X		PMUN1036A	Remote Assy, Radio End with QuickDisconnect			
				X	HLN6961_	Accessory Connector Remote Mount			
X					HUE2201_	Tanapa UHF R1 40W			

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

**ASTRO XTL 5000 O3 UHF Range 1 10-40 Watt Model Chart (Cont.)**

<b>M20QSS9PW1AN</b>														
<b>Option</b>										<b>Description</b>				
G159AH										ADD: XTL Encryption UCM HW 30 Sec Key				
G159AJ										ADD: XTL Encryption UCM HW 3 Day Sec Key Ret				
W874AA										ADD: Handset/Hangup Armored Cable (GCAI)				
G874AA										ADD: Handset/Hangup (GCAI)				
G876AA										ADD: Hangup/Cradle w/Coiled Cable, GCAI				
W872AA										ADD: Visor Mic Standard				
W22AW										ADD: STD Palm Mic GCAI				
G233AC										ADD: Gooseneck PTT Millennium				
W20BX										ALT: Keypad Microphone				
W382AH										ALT: Control Station Palm Microphone				
W665BE										ADD: Control Station Base Mount				
G91AB										ADD: Control Station Power Supply				
W688AP										ADD: External Emergency Pushbutton				
W81AL										ADD: Key Lock Mount				
										<b>Item No.</b>		<b>Description</b>		
X										HLN6919		Secure Interface Board 30 Sec Key Retention		
	X									HLN6918_		Secure Interface Board 3 Day Key Retention		
X	X									NNTN5032_		UCM II Mode		
		X								HKN1018_		Handset/Hangup Normal Armored Cable		
			X							HLN1457_		Handset/Hangup (Hangup Cup)		
				X						HKN1017_		Handset/Hangup Coiled Cable		
					X					HMN4089_		Visor Mic Remote Mount		
						X				HMN1090_		Std Palm Mic GCAI		
							X			HMN1087_		Gooseneck PTT		
								X		HMN4079_		Keypad Microphone		
									X	HMN1088_		Control Station Desk Microphone		
									X	HLN6042_		Control Station Mount		
									X	HPN4007_		Power Supply		
									X	HLN6372_		Keylock Mount		
									X	HLN5131_		Emergency Button		
									X	HLN6047_		Hardware Installation Base Tray		
									X	6880101W87		Spectra Controller Station Instructor Manual		
									X	6880102W93		Spectra Maxtrac Controller Base Manual		
X	X									0310907A20		Screw M3 x 0.5 x 10		
X	X									2685498E02		Shield		

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

## ASTRO XTL 5000 O3 UHF Range 1 10-40 Watt Model Chart (Cont.)

M20QSS9PW1AN													
Option										Description			
W116AN										ADD: External Alarm and Relay Cable			
W591AP										ADD: Auxiliary Switch Panel			
B18CL										ADD: Auxiliary Spkr Spectra 5 Watt			
W432AE										ADD: External 13 Watt Speaker			
G425AA										ADD: Antenna 1/4 Wave Whip 380-420 MHz			
G426AA										ADD: Antenna 1/4 Wave Whip 450-470 MHz			
G427AA										ADD: Antenna 3.5 dB 380-420 MHz			
G428AA										ADD: Antenna 3.5 dB 450-470 MHz			
G429AA										ADD: Antenna 5.0 dB 380-420 MHz			
G430AA										ADD: Antenna 5.0 dB 450-470 MHz			
G431AA										ADD: Antenna Wideband 380-470 MHz			
										Item No.		Description	
X										TLN4533_		Relays	
X										HKN4258_		Cable Relay	
	X									HLN1196_		Auxiliary Switch Panel	
		X								HSN4031_		External 7.5 Watt Speaker	
			X							HSN4032_		External 13 Watt Speaker	
				X						HAE4003_		Antenna, 1/4 Wave 450-470 MHz	
					X					HAE4011_		Antenna, Roof Top 3.5 dB	
						X				HAE6010_		Antenna, 3.5 dB Gain 380-433 MHz	
							X			HAE6011_		Antenna, 5.0 dB Gain 380-433 MHz	
				X						HAE6012_		Antenna, 1/4 Wave Whip 380-433 MHz	
								X		HAE6013_		Antenna, Wideband 2.0 dB Gain 380-470 MHz	
								X		RAE4014ARB		Antenna, 5.0 dB 450-470 MHz	

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

## ASTRO XTL 5000 O3 UHF Range 1 100 Watt Model Chart

M20QTS9PW1AN									
Option					Description				
				G66AH	ADD: Dash Mount Mid Power O3				
				G67AZ	ADD: Remote Mount Mid Power O3				
				G67AY	ADD: Remote Mount High Power O3				
				G655AH	ADD: Quick Release Remote Mount O3 High Power				
				G72AC	ADD: XTL5000 O3 Control Head				
					Item No. Description				
X	X	X	X	X	0364332H02	M3 x 5 screw			
				X	0364583H01	Screw, M6 x 1, Hex Socket			
			X	X	3064658H04	High Power TIB Flex Kit			
X	X	X	X	X	3285471E01	Seal Headbridge			
				X	5564610H02	Handle Assembly			
				X	5564957H01	Key Lock			
X	X	X	X	X	5684275A05	Bag Air Plastic 10" x 10"			
X	X				HKN4192B	Mobile Power CBL High Power 20'			
			X	X	HKN6110_	Cable, Power, 100W			
X	X				HKN6190B	Mid Power TIB Flex Kit			
X	X				HLN6861A	Hardware XTL 5000 Standard Install			
X	X	X	X	X	HLN6863A	Accessory Connection XTL 5000			
				X	HLN6909_	Quick Release HiPower Trunnion			
			X		HLN6910_	Screw, HiPower Trunnion			
X	X	X	X	X	HLN6954_	Cover, Dust, Kit			
		X	X	X	PMLN4958A	O3 CAN 17' Extension Cable			
		X	X	X	PMLN4959A	O3 Accessory Cable			
				X	PMUN1034A	O3 Handheld Control Head			
X	X	X	X	X	PMUN1036A	Remote Assy, Radio End with QuickDisconnect			
X					HUE2202_	Tanapa UHF R1 100W			

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

## ASTRO XTL 5000 O3 UHF Range 1 100 Watt Model Chart (Cont.)

M20QTS9PW1AN											
Option						Description					
G927AA						INT: Connector Remote Mount					
G442AA						ADD:XTL 5000 Control Head					
G159AH						ADD: XTL Encryption UCM HW 30 Sec Key					
G159AJ						ADD: XTL Encryption UCM HW 3 Day Sec Key Ret					
W874AA						ADD: Handset/Hangup Armored Cable (GCAI)					
G874AA						ADD: Handset/Hangup (GCAI)					
G876AA						ADD: Hangup/Cradle w/Coiled CBL, GCAI					
W872AA						ADD: Visor Mic Standard					
W22AW						ADD: STD Palm Mic GCAI					
G233AC						ADD: Gooseneck PTT Millennium					
W20BX						ALT: Keypad Microphone					
						Item No.		Description			
X						HLN6961_		Accessory Connector Remote Mount			
	X					HLN1466_		Control Head, XTL 5000			
		X				HLN6919_		Sec Interface Board 30 Sec Key Retention			
		X	X			NNTN5032_		UCM II Mode			
			X			HLN6918_		Sec Interface Board 3 Day Key Retention			
				X		HKN1018_		Handset/Hangup Normal Armored Cable			
					X	HLN1457_		Handset/Hangup (Hangup Cup)			
						HKN1017_		Handset/Hangup Coiled Cable			
						HMN4089_		Visor Mic Remote Mount			
						HMN1090_		Std Palm Mic GCAI			
						HMN1087_	X	Gooseneck PTT			
						HMN4079_	X	Keypad Microphone			
		X	X			0310907A20		Screw M3 x 0.5 x 10			
		X	X			2685498E02		Shield			

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

**ASTRO XTL 5000 O3 UHF Range 1 100 Watt Model Chart (Cont.)**

<b>M20QTS9PW1AN</b>													
<b>Option</b>										<b>Description</b>			
W688AP										ADD: External Emergency Pushbutton			
W81AL										ADD: Key Lock Mount			
W116AN										ADD: External Alarm and Relay Cable			
W591AP										ADD: Auxiliary Switch Panel			
B18CL										ADD: Auxiliary Spkr Spectra 5 Watt			
W432AE										ADD: External 13 Watt Speaker			
G425AA										ADD: Antenna 1/4 Wave Whip 380-420 MHz			
G426AA										ADD: Antenna 1/4 Wave Whip 450-470 MHz			
G427AA										ADD: Antenna 3.5 dB 380-420 MHz			
G428AA										ADD: Antenna 3.5 dB 450-470 MHz			
G429AA										ADD: Antenna 5.0 dB 380-420 MHz			
G430AA										ADD: Antenna 5.0 dB 450-470 MHz			
G431AA										ADD: Antenna Wideband 380-470 MHz			
										<b>Item No.</b>		<b>Description</b>	
X										HLN5131_		Emergency Button	
	X									HLN6372_		Keylock Mount	
		X								TLN4533_		Relays	
		X								HKN4258_		Cable Relay	
			X							HLN1196_		Auxiliary Switch Panel	
				X						HSN4031_		External 7.5 Watt Speaker	
					X					HSN4032_		External 13 Watt Speaker	
						X				HAE4003_		Antenna, 1/4 Wave 450-470 MHz	
							X			HAE4011_		Antenna, Roof Top 3.5 dB	
								X		HAE6010_		Antenna, 3.5 dB Gain 380-433 MHz	
									X	HAE6011_		Antenna, 5.0 dB Gain 380-433 MHz	
					X					HAE6012_		Antenna, 1/4 Wave Whip 380-433 MHz	
									X	HAE6013_		Antenna, Wideband 2.0 dB Gain 380-470 MHz	
									X	RAE4014ARB		Antenna, 5.0 dB 450-470 MHz	

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.



## ASTRO XTL 5000 O3 UHF Range 2 10-40 Watt Model Chart

M20SSS9PW1AN									
Option					Description				
				G66AH		ADD: Dash Mount Mid Power O3			
				G67AZ		ADD: Remote Mount Mid Power O3			
				G67AY		ADD: Remote Mount High Power O3			
				G655AH		ADD: Quick Release Remote Mount O3 High Power			
				G72AC		ADD: XTL5000 O3 Control Head			
				G927AA		INT: Connector Remote Mount			
					Item No.	Description			
	X	X	X	X	0364332H02	M3 x 5 screw			
				X	0364583H01	Screw, M6 x 1, Hex Socket			
			X	X	3064658H04	High Power TIB Flex Kit			
	X	X	X	X	3285471E01	Seal Headbridge			
				X	5564610H02	Handle Assembly			
				X	5564957H01	Key Lock			
	X	X	X	X	5684275A05	Bag Air Plastic 10" x 10"			
	X	X			HKN4192B	Mobile Power CBL High Power 20'			
			X	X	HKN6110_	Cable, Power, 100W			
	X	X			HKN6190B	Mid Power TIB Flex Kit			
	X	X			HLN6861A	Hardware XTL 5000 Standard Install			
	X	X	X	X	HLN6863A	Accessory Connection XTL 5000			
				X	HLN6909_	Quick Release HiPower Trunnion			
			X		HLN6910_	Screw, HiPower Trunnion			
	X	X	X	X	HLN6954_	Cover, Dust, Kit			
		X	X	X	PMLN4958A	O3 CAN 17' Extension Cable			
		X	X	X	PMLN4959A	O3 Accessory Cable			
				X	PMUN1034A	O3 Handheld Control Head			
	X	X	X	X	PMUN1036A	Remote Assy, Radio End with QuickDisconnect			
				X	HLN6961_	Accessory Connector Remote Mount			
X					HUE4042_	Tanapa UHF R2 45W			

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

**ASTRO XTL 5000 O3 UHF Range 2 10-40 Watt Model Chart (Cont.)**

M20SSS9PW1AN																	
Option										Description							
G159AH										ADD: XTL Encryption UCM HW 30 Sec Key							
G159AJ										ADD: XTL Encryption UCM HW 3 Day Sec Key Ret							
W874AA										ADD: Handset/Hangup Armored Cable (GCAI)							
G874AA										ADD: Handset/Hangup (GCAI)							
G876AA										ADD: Hangup/Cradle w/Coiled CBL, GCAI							
W872AA										ADD: Visor Mic Standard							
W22AW										ADD: STD Palm Mic GCAI							
G233AC										ADD: Gooseneck PTT Millennium							
W20BX										ALT: Keypad Microphone							
W382AH										ALT: Control Station Palm Microphone							
W665BE										ADD: Control Station Base Mount							
G91AB										ADD: Control Station Power Supply							
W688AP										ADD: External Emergency Pushbutton							
W81AL										ADD: Key Lock Mount							
										Item No.		Description					
	X									HLN6919_	Secure Interface Board 30 Sec Key Retention						
		X								HLN6918	Secure Interface Board 3 Day Key Retention						
	X	X								NNTN5032_	UCM II Mode						
			X							HKN1018_	Handset/Hangup Normal Armored Cable						
				X						HLN1457_	Handset/Hangup (Hangup Cup)						
					X					HKN1017_	Handset/Hangup Coiled Cable						
						X				HMN4089_	Visor Mic Remote Mount						
							X			HMN1090_	Std Palm Mic GCAI						
								X		HMN1087_	Gooseneck PTT						
									X	HMN4079_	Keypad Microphone						
										X	HMN1088_	Control Station Desk Microphone					
										X	HLN6042_	Control Station Mount					
											X	HPN4007_	Power Supply				
												X	HLN6188_	Emergency Pushbutton			
												X	HLN6372_	Keylock Mount			
												X	HLN5131_	Emergency Button			
									X	HLN6047_	Hardware Installation Base Tray						
	X	X								0310907A20	Screw M3 x 0.5 x 10						
	X	X								2685498E02	Shield						
									X	6880101W87	Spectra Controller Station Instructor Manual						
									X	6880102W93	Spectra Maxtrac Controller Base Manual						

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

## ASTRO XTL 5000 O3 UHF Range 2 10-40 Watt Model Chart (Cont.)

M20SSS9PW1AN													
Option										Description			
W116AN										ADD: External Alarm and Relay Cable			
W591AP										ADD: Auxiliary Switch Panel			
B18CL										ADD: Auxiliary Spkr Spectra 5 Watt			
W432AE										ADD: External 13 Watt Speaker			
G425AA										ADD: Antenna 1/4 Wave Whip 380-420 MHz			
G426AA										ADD: Antenna 1/4 Wave Whip 450-470 MHz			
G427AA										ADD: Antenna 3.5 dB 380-420 MHz			
G428AA										ADD: Antenna 3.5 dB 450-470 MHz			
G429AA										ADD: Antenna 5.0 dB 380-420 MHz			
G430AA										ADD: Antenna 5.0 dB 450-470 MHz			
G431AA										ADD: Antenna Wideband 380-470 MHz			
										Item No.		Description	
X										TLN4533_		Relays	
X										HKN4258_		Cable Relay	
	X									HLN1196_		Auxiliary Switch Panel	
		X								HSN4031_		External 7.5 Watt Speaker	
			X							HSN4032_		External 13 Watt Speaker	
				X						HAE4003_		Antenna, 1/4 Wave 450-470 MHz	
					X					HAE4011_		Antenna, Roof Top 3.5 dB	
						X				HAE6010_		Antenna, 3.5 dB Gain 380-433 MHz	
							X			HAE6011_		Antenna, 5.0 dB Gain 380-433 MHz	
				X						HAE6012_		Antenna, 1/4 Wave Whip 380-433 MHz	
								X		HAE6013_		Antenna, Wideband 2.0 dB Gain 380-470 MHz	
								X		RAE4014ARB		Antenna, 5.0 dB 450-470 MHz	

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

## ASTRO XTL 5000 O3 700-800 MHz 10-35 Watt Model Chart

M20URS9PW1AN									
Option					Description				
					G66AH	ADD: Dash Mount Mid Power O3			
					G67AZ	ADD: Remote Mount Mid Power O3			
					G67AY	ADD: Remote Mount High Power O3			
					G655AH	ADD: Quick Release Remote Mount O3 High Power			
					G72AC	ADD: XTL5000 O3 Control Head			
					G927AA	INT: Connector Remote Mount			
					Item No.	Description			
	X	X	X	X	0364332H02	M3 x 5 screw			
				X	0364583H01	Screw, M6 x 1, Hex Socket			
			X	X	3064658H04	High Power TIB Flex Kit			
	X	X	X	X	3285471E01	Seal Headbridge			
				X	5564610H02	Handle Assembly			
				X	5564957H01	Key Lock			
	X	X	X	X	5684275A05	Bag Air Plastic 10" x 10"			
	X	X			HKN4192B	Mobile Power CBL High Power 20'			
			X	X	HKN6110_	Cable, Power, 100W			
	X	X			HKN6190B	Mid Power TIB Flex Kit			
	X	X			HLN6861A	Hardware XTL 5000 Standard Install			
	X	X	X	X	HLN6863A	Accessory Connection XTL 5000			
				X	HLN6909_	Quick Release HiPower Trunnion			
			X		HLN6910_	Screw, HiPower Trunnion			
	X	X	X	X	HLN6954_	Cover, Dust, Kit			
		X	X	X	PMLN4958A	O3 CAN 17' Extension Cable			
		X	X	X	PMLN4959A	O3 Accessory Cable			
				X	PMUN1034A	O3 Handheld Control Head			
	X	X	X	X	PMUN1036A	Remote Assy, Radio End with QuickDisconnect			
				X	HLN6961_	Accessory Connector Remote Mount			
X					HUF1291_	Tanapa 700-800 35W			

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

## ASTRO XTL 5000 O3 700-800 MHz 10-35 Watt Model Chart (Cont.)

M20URS9PW1AN														
Option										Description				
G159AH										ADD: XTL Encryption UCM HW 30 Sec Key				
G159AJ										ADD: XTL Encryption UCM HW 3 Day Sec Key Ret				
W874AA										ADD: Handset/Hangup Armored Cable (GCAI)				
G874AA										ADD: Handset/Hangup (GCAI)				
G876AA										ADD: Hangup/Cradle w/Coiled CBL, GCAI				
W872AA										ADD: Visor Mic Standard				
W22AW										ADD: STD Palm Mic GCAI				
G233AC										ADD: Gooseneck PTT Millennium				
W20BX										ALT: Keypad Microphone				
W382AH										ALT: Control Station Palm Microphone				
W665BE										ADD: Control Station Base Mount				
G91AB										ADD: Control Station Power Supply				
W688AP										ADD: External Emergency Pushbutton				
W81AL										ADD: Key Lock Mount				
										Item No.		Description		
X										HLN6919_		Secure Interface Board 30 Sec Key Retention		
	X									HLN6918_		Secure Interface Board 3 Day Key Retention		
X	X									NNTN5032_		UCM II Mode		
		X								HKN1018_		Handset/Hangup Normal Armored Cable		
			X							HLN1457_		Handset/Hangup (Hangup Cup)		
				X						HKN1017_		Handset/Hangup Coiled Cable		
					X					HMN4089_		Visor Mic Remote Mount		
						X				HMN1090_		Std Palm Mic GCAI		
							X			HMN1087_		Gooseneck PTT		
								X		HMN4079_		Keypad Microphone		
									X	HMN1088_		Control Station Desk Microphone		
									X	HLN6042_		Control Station Mount		
									X	HPN4007_		Power Supply		
									X	HLN6372_		Keylock Mount		
									X	HLN5131_		Emergency Button		
								X		HLN6047_		Hardware Installation Base Tray		
X	X									0310907A20		Screw M3 x 0.5 x 10		
X	X									2685498E02		Shield		
								X		6880101W87		Spectra Controller Station Instructor Manual		
								X		6880102W93		Spectra Maxtrac Controller Base Manual		

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

**ASTRO XTL 5000 O3 700-800 MHz 10-35 Watt Model Chart (Cont.)**

<b>M20URSM9PW1AN</b>									
<b>Option</b>							<b>Description</b>		
						W116AN	ADD: External Alarm and Relay Cable		
						W591AP	ADD: Auxiliary Switch Panel		
						B18CL	ADD: Auxiliary Spkr Spectra 5 Watt		
						W432AE	ADD: External 13 Watt Speaker		
						W484AD	ALT: Antenna 3 dB Gain 762-870 MHz		
						G335AT	ADD: Antenna 1/4 Wave 762-870 MHz		
						G174AA	ADD: Antenna 3 dB Low Profile 762-870 MHz		
						G175AA	ADD: Antenna 3 dB Elvat Feed 762-870 MHz		
							<b>Item No.</b>	<b>Description</b>	
	X						TLN4533_	Relays	
	X						HKN4258_	Cable Relay	
		X					HLN1196_	Auxiliary Switch Panel	
			X				HSN4031_	External 7.5 Watt Speaker	
				X			HSN4032_	External 13 Watt Speaker	
					X		HAF4013_	Antenna, 3 dB Low Profile 762-870 MHz	
						X	HAF4014_	Antenna, 3 dB Elevated Feed 762-870 MHz	
					X		HAF4016_	1/4 Wave Antenna 762-870 MHz	
				X			HAF4017_	Antenna, 3 dB Collinear 762-870 MHz	

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

## ASTRO XTL 5000 O3 700-800 MHz 10-35 Watt (Reband) Model Chart

M20URS9PW1AN																			
Option										Description									
G927AA										INT: Connector Remote Mount									
G442AC										ADD: XTL 5000 Control Head RB									
G442AE										ADD: XTL 5000 Control Head Dash UCM RB									
G159AH										ADD: XTL Encryption UCM HW 30 Sec Key									
G159AJ										ADD: XTL Encryption UCM HW 3 Day Sec Key Ret									
W874AA										ADD: Handset/Hangup Armored Cable (GCAI)									
G874AA										ADD: Handset/Hangup (GCAI)									
G876AA										ADD: Hangup/Cradle w/Coiled CBL, GCAI									
W872AA										ADD: Visor Mic Standard									
W22AW										ADD: STD Palm Mic GCAI									
G233AC										ADD: Gooseneck PTT Millennium									
W20BX										ALT: Keypad Microphone									
W382AH										ALT: Control Station Palm Microphone									
W665BE										ADD: Control Station Base Mount									
										Item No.		Description							
	X									HLN6961_		Accessory Connector Remote Mount							
		X								PMUF1266_		Control Head with CHIB							
			X							HLN1466_		Control Head							
				X						HLN6919_		Secure Interface Board 30 Sec Key Retention							
				X	X					NNTN5032_		UCM II Mode							
				X						HLN6918_		Secure Interface Board 3 Day Key Retention							
					X					HKN1018_		Handset/Hangup Normal Armored Cable							
						X				HLN1457_		Handset/Hangup (Hangup Cup)							
							X			HKN1017_		Handset/Hangup Coiled Cable							
								X		HMN4089_		Visor Mic Remote Mount							
									X	HMN1090_		Std Palm Mic GCAI							
									X	HMN1087_		Gooseneck PTT							
									X	HMN4079_		Keypad Microphone							
									X	HMN1088_		Control Station Desk Microphone							
									X	HLN6042_		Control Station Mount							
									X	HLN6047_		Hardware Installation Base Tray							
				X	X					0310907A20		Screw M3 x 0.5 x 10							
				X	X					2685498E02		Shield							
									X	6880101W87		Spectra Controller Station Instructor Manual							
									X	6880102W93		Spectra Maxtrac Controller Base Manual							

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

## ASTRO XTL 5000 O3 700-800 MHz 10-35 Watt (Reband) Model Chart (Cont.)

M20URS9PW1AN											
Option										Description	
G91AB										ADD: Control Station Power Supply	
W688AP										ADD: External Emergency Pushbutton	
W81AL										ADD: Key Lock Mount	
W116AN										ADD: External Alarm and Relay Cable	
W591AP										ADD: Auxiliary Switch Panel	
B18CL										ADD: Auxiliary Spkr Spectra 5 Watt	
W432AE										ADD: External 13 Watt Speaker	
W484AD										ALT: Antenna 3 dB Gain 762-870 MHz	
G335AT										ADD: Antenna 1/4 Wave 762-870 MHz	
G174AA										ADD: Antenna 3 dB Low Profile 762-870 MHz	
G175AA										ADD: Antenna 3 dB Elvat Feed 762-870 MHz	
										Item No.	Description
	X									HPN4007_	Power Supply
		X								HLN5131_	Emergency Button
			X							HLN6372_	Keylock Mount
				X						TLN4533_	Relays
				X						HKN4258_	Cable Relay
					X					HLN1196_	Auxiliary Switch Panel
						X				HSN4031_	External 7.5 Watt Speaker
							X			HSN4032_	External 13 Watt Speaker
								X		HAF4013_	Antenna, 3 dB Low Profile 762-870 MHz
									X	HAF4014_	Antenna, 3 dB Elevated Feed 762-870 MHz
									X	HAF4016_	1/4 Wave Antenna 762-870 MHz
							X			HAF4017_	Antenna, 3 dB Collinear 762-870 MHz

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.



## ASTRO XTL 5000 O5 VHF 10-50 Watt Model Chart

M20KSM9PW1AN														
Option										Description				
G66AF										ADD: Dash Mount, No Control Head				
G66AD										ADD: Dash Mount				
G67AP										ADD: Mid Remote Mount				
G67AR										ADD: Remote Mount, No Control Head				
G582AA										ADD: Remote Mount Cable 40 meters (131 ft)				
G879AA										ADD: Remote Mount Cable 35 meters (115 ft)				
G607AA										ADD: Remote Mount Cable 23 meters (75 ft)				
G609AA										ADD: Remote Mount Cable 15 meters (50 ft)				
G610AA										ADD: Remote Mount Cable 10 meters (30 ft)				
G628AA										INT: Remote Mount Cable 5 meters (17 ft)				
G618AA										ADD: Remote Mount Cable 3 meters (10 ft)				
G442AB										ADD:XTL 5000 Control Head				
G159AH										ADD: XTL Encryption UCM HW 30 Sec Key				
G159AJ										ADD: XTL Encryption UCM HW 3 Day Sec Key Ret				
										Item No.		Description		
		X	X								HKN4192_	Mobile Power Cable HiPower 20 ft		
		X									HKN6186_	Trunnion, Control Head Remote Mount		
		X									HKN6188_	Cable, Control Head Power and Speaker		
		X	X								HKN6190_	Cable, Front Remote Flex Assy for Transceiver		
		X									HKN6191_	Cable, Rear Remote Flex Assy for Control Head		
	X										HKN6192_	Cable, Control Head Flex Assy (Dash)		
		X	X								HLN1454_	Remote Assy, Radio End		
	X										HLN6960_	Dash Mount No Control Head Hardware Kit		
	X	X	X	X							HLN6861_	Hardware Std Install		
	X	X									HKN4191_	Mobile Power Cable HiPower		
		X									HLN6954_	Cover, Dust, Kit		
	X	X	X	X							HLN6970_	Wing Screw Torque Tool Kit		
		X	X								HHN4048_	Hardware Kit, Transceiver Attachment		
				X							HKN6164_	Remote Mount Cable 40 meters (131 ft)		
					X						HKN6165_	Remote Mount Cable 35 meters (115 ft)		
						X					HKN6166_	Remote Mount Cable 23 meters (75 ft)		
							X				HKN6167_	Remote Mount Cable 15 meters (50 ft)		
								X			HKN6168_	Remote Mount Cable 10 meters (30 ft)		
									X		HKN6169_	Remote Mount Cable 5 meters (17 ft)		
										X	HKN6170_	Remote Mount Cable 3 meters (10 ft)		
	X	X		X							HLN6863_	Accessory Connector		
										X	MHLN6919_	Secure Interface Board 30 Sec Key Retention		
										X	MHLN6918_	Secure Interface Board 3 Day Key Retention		
X											HUD1793_	Tanapa VHF 50W		
										X	HLN1467_	Control Head, XTL 5000		
		X									HLN1468_	Control Head, Remote Assembly		
		X									1515048C01	Dust Cover		
		X									1585245E02	Radio Housing		
		X									0364332H02	M3 x 5 Screw		
		X									3285471E01	Seal Headbridge		
									X	X	0310907A20	Screw M3 x 0.5 x 10		
									X	X	2685498E02	Shield		

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

**ASTRO XTL 5000 O5 VHF 10-50 Watt Model Chart (Cont.)**

M20KSM9PW1AN															
Option										Description					
G927AA										INT: Connector Remote Mount					
W874AA										ADD: Handset/Hangup Armoured Cable (GCAI)					
G874AA										ADD: Handset/Hangup (GCAI)					
G876AA										ADD: Hangup/Cradle w/Coiled CBL, GCAI					
W872AA										ADD: Visor Mic Standard					
W22AW										ADD: STD Palm Mic GCAI					
G233AC										ADD: Gooseneck PTT Millennium					
W20BX										ALT: Keypad Microphone					
W382AH										ALT: Control Station Palm Microphone					
W665BE										ADD: Control Station Base Mount					
G91AB										ADD: Control Station Power Supply					
W688AP										ADD: External Emergency Pushbutton					
W81AL										ADD: Key Lock Mount					
W116AN										ADD: External Alarm and Relay Cable					
										Item No.		Description			
	X									HLN6961_	Accessory Connector Remote Mount				
		X								HKN1018_	Handset/Hangup Normal Armoured Cable				
			X							HLN1457_	Handset/Hangup (Hangup Cup)				
				X						HKN1017_	Handset/Hangup Coiled Cable				
					X					HMN4089_	Visor Mic Remote Mount				
						X				HMN1090_	Std Palm Mic GCAI				
							X			HMN1087_	Gooseneck PTT				
								X		HMN4079_	Keypad Microphone				
									X	HMN1088_	Control Station Desk Microphone				
										HLN6042_	Control Station Mount				
										HPN4007_	Power Supply				
										HLN6188_	Emergency Pushbutton				
										HLN6372_	Keylock Mount				
										X	HLN6969_	External Alarm Kit			
										X	HKN4258_	Cable Relay			
										X	HLN5131_	Emergency Button			
										X	HLN6047_	Hardware Installation Base Tray			
										X	6880101W87	Spectra Controller Station Instructor Manual			
										X	6880102W93	Spectra Maxtrac Controller Base Manual			

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

## ASTRO XTL 5000 O5 VHF 10-50 Watt Model Chart (Cont.)

M20KSM9PW1AN											
Option										Description	
W591AP										ADD: Auxiliary Switch Panel	
B18CL										ADD: Auxiliary Spkr Spectra 5 Watt	
W432AE										ADD: External 13 Watt Speaker	
G296AA										ADD: Antenna 1/4 Wave Whip Roof Top 136-144 MHz	
G297AA										ADD: Antenna 1/4 Wave Roof Top VHF 144-150.8 MHz	
G299AA										ADD: Antenna 1/4 Wave Roof Top VHF 150.8-162 MHz	
G300AA										ADD: Antenna 1/4 Wave Roof Top VHF 162-174 MHz	
G301AA										ADD: Antenna 3 dB Roof Top VHF 136-174 MHz	
W652AE										ADD: 1/4 Wave Broadband Antenna 136-162 MHz	
G629AA										ADD: 1/4 Wave Broadband Antenna 146-174 MHz	
										Item No.	Description
X										HLN1196_	Auxiliary Switch Panel
	X									HSN4031_	External 7.5 Watt Speaker
		X								HSN4032_	External 13 Watt Speaker
			X							HAD4006_	1/4 Wave Whip Antenna Roof Top
				X						HAD4007_	1/4 Wave, Roof Top VHF
					X					HAD4008_	1/4 Wave Roof Top
						X				HAD4009_	1/4 Wave Roof Top
							X			HAD4016_	1/4 Wave Broadband Antenna 136-162 MHz
								X		HAD4017_	1/4 Wave Broadband Antenna 146-174 MHz
								X		RAD4010ARB	3 dB Tunable Antenna

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

## ASTRO XTL 5000 O5 VHF 100 Watt Model Chart

M20KTM9PW1AN									
Option					Description				
G67AQ					ADD: Remote Mount, No Control Head				
G67AK					ADD: Thumb Screw, Remote Mount				
G655AF					ADD: Quick, HP Remote Mount No Control Head				
G655AE					ADD: Quick, HP Remote Mount				
G582AA					ADD: Remote Mount Cable 40 meters (131 ft)				
G879AA					ADD: Remote Mount Cable 35 meters (115 ft)				
G607AA					ADD: Remote Mount Cable 23 meters (75 ft)				
G609AA					ADD: Remote Mount Cable 15 meters (50 ft)				
G610AA					ADD: Remote Mount Cable 10 meters (30 ft)				
G628AA					INT: Remote Mount Cable 5 meters (17 ft)				
G618AA					ADD: Remote Mount Cable 3 meters (10 ft)				
G442AB					ADD:XTL 5000 Control Head				
					Item No.	Description			
	X	X			HKN6186_	Trunnion, Control Head Remote Mount			
	X	X			HKN6188_	Cable, Control Head Power and Speaker			
	X	X			HKN6191_	Cable, Rear Remote Flex Assy for Control Head			
	X	X			HLN1468_	Control Head, Remote Assembly			
X	X	X	X		HLN1454_	Remote Assy, Radio End			
	X	X	X		HLN6954_	Cover, Dust, Kit			
X	X				HLN6970_	Wing Screw Torque Tool Kit			
X		X			HHN4048_	Hardware Kit, Transceiver Attachment			
X	X	X	X		HKN6110_	Cable, Power, 100W			
				X	HKN6164_	Remote Mount Cable 40 meters (131 ft)			
				X	HKN6165_	Remote Mount Cable 35 meters (115 ft)			
				X	HKN6166_	Remote Mount Cable 23 meters (75 ft)			
				X	HKN6167_	Remote Mount Cable 15 meters (50 ft)			
				X	HKN6168_	Remote Mount Cable 10 meters (30 ft)			
				X	HKN6169_	Remote Mount Cable 5 meters (17 ft)			
				X	HKN6170_	Remote Mount Cable 3 meters (10 ft)			
X	X				HLN6910_	Screw, HiPower Trunnion			
		X	X		HLN6909_	Quick Release HiPower Trunnion			
				X	HLN1467_	Control Head, XTL 5000			
X					HUD1794_	Tanapa VHF 100W			
	X	X	X	X	3064658H03	Cable, 60 pin, Male			
		X	X		0364332H02	M3 x 5 screw			
		X	X		0364583H01	Screw, M6 x 1, Hex Socket			
		X	X		3285471E01	Seal Headbridge			
		X	X		5564610H02	Handle Assembly			
		X	X		5564957H01	Key Lock			

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

## ASTRO XTL 5000 O5 VHF 100 Watt Model Chart (Cont.)

M20KTM9PW1AN									
Option					Description				
G159AH					ADD: XTL Encryption UCM HW 30 Sec Key				
G159AJ					ADD: XTL Encryption UCM HW 3 Day Sec Key Ret				
G927AA					INT: Connector Remote Mount				
W874AA					ADD: Handset/Hangup Armoured Cable (GCAI)				
G874AA					ADD: Handset/Hangup (GCAI)				
G876AA					ADD: Hangup/Cradle w/Coiled CBL, GCAI				
W872AA					ADD: Visor Mic Standard				
W22AW					ADD: STD Palm Mic GCAI				
G233AC					ADD: Gooseneck PTT Millennium				
W20BX					ALT: Keypad Microphone				
W688AP					ADD: External Emergency Pushbutton				
					Item No.	Description			
		X			HLN6961_	Accessory Connector Remote Mount			
X					MHLN6919_	Sec Interface Board 30 Sec Key Retention			
	X				MHLN6918_	Sec Interface Board 3 Day Key Retention			
			X		HKN1018_	Handset/Hangup Normal Armoured Cable			
				X	HLN1457_	Handset/Hangup (Hangup Cup)			
				X	HKN1017_	Handset/Hangup Coiled Cable			
					HMN4089_	Visor Mic Remote Mount			
					HMN1090_	Std Palm Mic GCAI			
					HMN1087_	Gooseneck PTT			
					HMN4079_	Keypad Microphone			
					X HLN6188_	Emergency Pushbutton			
					X HLN5131_	Emergency Button			
	X	X			0310907A20	Screw M3 x 0.5 x 10			
	X	X			2685498E02	Shield			

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

**ASTRO XTL 5000 O5 VHF 100 Watt Model Chart (Cont.)**

<b>M20KTM9PW1AN</b>											
<b>Option</b>										<b>Description</b>	
W81AL										ADD: Key Lock Mount	
W116AN										ADD: External Alarm and Relay Cable	
W591AP										ADD: Auxiliary Switch Panel	
B18CL										ADD: Auxiliary Spkr Spectra 5 Watt	
W432AE										ADD: External 13 Watt Speaker	
G296AA										ADD: Antenna 1/4 Wave Whip Roof Top 136-144 MHz	
G297AA										ADD: Antenna 1/4 Wave Roof Top VHF 144-150.8 MHz	
G299AA										ADD: Antenna 1/4 Wave Roof Top VHF 150.8-162 MHz	
G300AA										ADD: Antenna 1/4 Wave Roof Top VHF 162-174 MHz	
G301AA										ADD: Antenna 3 dB Roof Top VHF 136-174 MHz	
W652AE										ADD: 1/4 Wave Broadband Antenna 136-162 MHz	
G629AA										ADD: 1/4 Wave Broadband Antenna 146-174 MHz	
										<b>Item No.</b>	<b>Description</b>
X										HLN6372_	Keylock Mount
	X									HLN6969_	External Alarm Kit
	X									HKN4258_	Cable Relay
		X								HLN1196_	Auxiliary Switch Panel
			X							HSN4031_	External 7.5 Watt Speaker
				X						HSN4032_	External 13 Watt Speaker
					X					HAD4006_	1/4 Wave Whip Antenna Roof Top
						X				HAD4007_	1/4 Wave, Roof Top VHF
							X			HAD4008_	1/4 Wave Roof Top
								X		HAD4009_	1/4 Wave Roof Top
									X	HAD4016_	1/4 Wave Broadband Antenna 136-162 MHz
									X	HAD4017_	1/4 Wave Broadband Antenna 146-174 MHz
								X		RAD4010ARB	3 dB Tunable Antenna

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

# ASTRO XTL 5000 O5 UHF Range 1 10-40 Watt Model Chart

M20QSM9PW1AN														
Option										Description				
G66AD										ADD: Dash Mount				
G67AP										ADD: Mid Remote Mount				
G67AR										ADD: Remote Mount, No Control Head				
G582AA										ADD: Remote Mount Cable 40 meters (131 ft)				
G879AA										ADD: Remote Mount Cable 35 meters (115 ft)				
G607AA										ADD: Remote Mount Cable 23 meters (75 ft)				
G609AA										ADD: Remote Mount Cable 15 meters (50 ft)				
G610AA										ADD: Remote Mount Cable 10 meters (30 ft)				
G628AA										INT: Remote Mount Cable 5 meters (17 ft)				
G618AA										ADD: Remote Mount Cable 3 meters (10 ft)				
G442AB										ADD: XTL 5000 Control Head				
G927AA										INT: Connector Remote Mount				
										Item No.		Description		
		X	X							HKN4192_	Mobile Power Cable HiPower 20 ft			
		X								HKN6186_	Trunnion, Control Head Remote Mount			
		X								HKN6188_	Cable, Control Head Power and Speaker			
		X	X							HKN6190_	Cable, Front Remote Flex Assy for Transceiver			
		X								HKN6191_	Cable, Rear Remote Flex Assy for Control Head			
	X									HKN6192_	Cable, Control Head Flex Assy (Dash)			
		X	X							HLN1454_	Remote Assy, Radio End			
	X	X	X							HLN6861_	Hardware Std Install			
		X								HKN4191_	Mobile Power Cable HiPower			
		X								HLN6954_	Cover, Dust, Kit			
	X	X	X							HLN6970_	Wing Screw Torque Tool Kit			
	X		X							HHN4048_	Hardware Kit, Transceiver Attachment			
				X						HKN6164_	Remote Mount Cable 40 meters (131 ft)			
					X					HKN6165_	Remote Mount Cable 35 meters (115 ft)			
						X				HKN6166_	Remote Mount Cable 23 meters (75 ft)			
							X			HKN6167_	Remote Mount Cable 15 meters (50 ft)			
								X		HKN6168_	Remote Mount Cable 10 meters (30 ft)			
									X	HKN6169_	Remote Mount Cable 5 meters (17 ft)			
										X	HKN6170_	Remote Mount Cable 3 meters (10 ft)		
	X		X							HLN6863_	Accessory Connector			
										X	HLN6961_	Accessory Connector Remote Mount		
X										HUE2201_	Tanapa UHF R1 40W			
										X	HLN1467_	Control Head, XTL 5000		
		X								HLN1468_	Control Head, Remote Assembly			
	X									1515048C01	Dust Cover			
	X									1585245E02	Radio Housing			
		X								0364332H02	M3 x 5 Screw			
		X								3285471E01	Seal Headbridge			

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

**ASTRO XTL 5000 O5 UHF Range 1 10-40 Watt Model Chart (Cont.)**

M20QSM9PW1AN																
Option										Description						
G159AH										ADD: XTL Encryption UCM HW 30 Sec Key						
G159AJ										ADD: XTL Encryption UCM HW 3 Day Sec Key Ret						
W874AA										ADD: Handset/Hangup Armoured Cable (GCAI)						
G874AA										ADD: Handset/Hangup (GCAI)						
G876AA										ADD: Hangup/Cradle w/Coiled Cable, GCAI						
W872AA										ADD: Visor Mic Standard						
W22AW										ADD: STD Palm Mic GCAI						
G233AC										ADD: Gooseneck PTT Millennium						
W20BX										ALT: Keypad Microphone						
W382AH										ALT: Control Station Palm Microphone						
W665BE										ADD: Control Station Base Mount						
G91AB										ADD: Control Station Power Supply						
W688AP										ADD: External Emergency Pushbutton						
W81AL										ADD: Key Lock Mount						
										Item No.		Description				
	X									MHLN6919	Secure Interface Board 30 Sec Key Retention					
		X								MHLN6918_	Secure Interface Board 3 Day Key Retention					
			X							HKN1018_	Handset/Hangup Normal Armoured Cable					
				X						HLN1457_	Handset/Hangup (Hangup Cup)					
					X					HKN1017_	Handset/Hangup Coiled Cable					
						X				HMN4089_	Visor Mic Remote Mount					
							X			HMN1090_	Std Palm Mic GCAI					
								X		HMN1087_	Gooseneck PTT					
									X	HMN4079_	Keypad Microphone					
										X	HMN1088_ Control Station Desk Microphone					
											X	HLN6042_ Control Station Mount				
												X	HPN4007_ Power Supply			
											X	HLN6372_ Keylock Mount				
												X	HLN5131_ Emergency Button			
									X	HLN6047_		Hardware Installation Base Tray				
									X	6880101W87		Spectra Controller Station Instructor Manual				
									X	6880102W93		Spectra Maxtrac Controller Base Manual				
	X	X								0310907A20		Screw M3 x 0.5 x 10				
	X	X								2685498E02		Shield				

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)



# ASTRO XTL 5000 O5 UHF Range 1 10-40 Watt Model Chart (Cont.)

M20QSM9PW1AN												
Option										Description		
W116AN										ADD: External Alarm and Relay Cable		
W591AP										ADD: Auxiliary Switch Panel		
B18CL										ADD: Auxiliary Spkr Spectra 5 Watt		
W432AE										ADD: External 13 Watt Speaker		
G425AA										ADD: Antenna 1/4 Wave Whip 380-420 MHz		
G426AA										ADD: Antenna 1/4 Wave Whip 450-470 MHz		
G427AA										ADD: Antenna 3.5 dB 380-420 MHz		
G428AA										ADD: Antenna 3.5 dB 450-470 MHz		
G429AA										ADD: Antenna 5.0 dB 380-420 MHz		
G430AA										ADD: Antenna 5.0 dB 450-470 MHz		
G431AA										ADD: Antenna Wideband 380-470 MHz		
										Item No.	Description	
X										HLN6969_	External Alarm Kit	
X										HKN4258_	Cable Relay	
	X									HLN1196_	Auxiliary Switch Panel	
		X								HSN4031_	External 7.5 Watt Speaker	
			X							HSN4032_	External 13 Watt Speaker	
				X						HAE4003_	Antenna, 1/4 Wave 450-470 MHz	
					X					HAE4011_	Antenna, Roof Top 3.5 dB	
						X				HAE6010_	Antenna, 3.5 dB Gain 380-433 MHz	
							X			HAE6011_	Antenna, 5.0 dB Gain 380-433 MHz	
				X						HAE6012_	Antenna, 1/4 Wave Whip 380-433 MHz	
									X	HAE6013_	Antenna, Wideband 2.0 dB Gain 380-470 MHz	
								X		RAE4014ARB	Antenna, 5.0 dB 450-470 MHz	

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

## ASTRO XTL 5000 O5 UHF Range 1 100 Watt Model Chart

M20QTM9PW1AN									
Option								Description	
G67AQ								ADD: Remote Mount, No Control Head	
G67AK								ADD: Thumb Screw, Remote Mount	
G655AF								ADD: Quick HP Remote Mount, No Control Head	
G655AE								ADD: Quick HP Remote Mount	
G582AA								ADD: Remote Mount Cable 40 meters (131 ft)	
G879AA								ADD: Remote Mount Cable 35 meters (115 ft)	
G607AA								ADD: Remote Mount Cable 23 meters (75 ft)	
G609AA								ADD: Remote Mount Cable 15 meters (50 ft)	
G610AA								ADD: Remote Mount Cable 10 meters (30 ft)	
G628AA								INT: Remote Mount Cable 5 meters (17 ft)	
G618AA								ADD: Remote Mount Cable 3 meters (10 ft)	
								Item No.	Description
	X	X						HKN6186_	Trunnion, Control Head Remote Mount
	X	X						HKN6188_	Cable, Control Head Power and Speaker
	X	X						HKN6191_	Cable, Rear Remote Flex Assy for Control Head
	X							HLN1468_	Control Head, Remote Assembly
X	X	X	X					HLN1454_	Remote Assy, Radio End
	X	X						HLN6954_	Cover, Dust, Kit
X	X							HLN6970_	Wing Screw Torque Tool Kit
X		X						HHN4048_	Hardware Kit, Transceiver Attachment
X	X	X	X					HKN6110_	Cable, Power 100W
				X				HKN6164_	Remote Mount Cable 40 meters (131 ft)
					X			HKN6165_	Remote Mount Cable 35 meters (115 ft)
						X		HKN6166_	Remote Mount Cable 23 meters (75 ft)
							X	HKN6167_	Remote Mount Cable 15 meters (50 ft)
							X	HKN6168_	Remote Mount Cable 10 meters (30 ft)
							X	HKN6169_	Remote Mount Cable 5 meters (17 ft)
							X	HKN6170_	Remote Mount Cable 3 meters (10 ft)
	X	X						HLN6910_	Screw, HiPower Trunnion
			X	X				HLN6909_	Quick Release HiPower Trunnion
X								HUE2202_	Tanapa UHF R1 100W
	X	X	X	X				3064658H03	Cable, 60 pin, Male
		X		X				0364332H02	M3 x 5 screw
			X	X				0364583H01	Screw, M6 x 1, Hex Socket
		X		X				3285471E01	Seal Headbridge
			X	X				5564610H02	Handle Assembly
		X	X					5564957H01	Key Lock

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

# ASTRO XTL 5000 O5 UHF Range 1 100 Watt Model Chart (Cont.)

M20QTM9PW1AN											
Option										Description	
G927AA										INT: Connector Remote Mount	
G442AB										ADD:XTL 5000 Control Head	
G159AH										ADD: XTL Encryption UCM HW 30 Sec Key	
G159AJ										ADD: XTL Encryption UCM HW 3 Day Sec Key Ret	
W874AA										ADD: Handset/Hangup Armoured Cable (GCAI)	
G874AA										ADD: Handset/Hangup (GCAI)	
G876AA										ADD: Hangup/Cradle w/Coiled CBL, GCAI	
W872AA										ADD: Visor Mic Standard	
W22AW										ADD: STD Palm Mic GCAI	
G233AC										ADD: Gooseneck PTT Millennium	
W20BX										ALT: Keypad Microphone	
										Item No.	Description
	X									HLN6961_	Accessory Connector Remote Mount
		X								HLN1467_	Control Head, XTL 5000
			X							MHLN6919_	Sec Interface Board 30 Sec Key Retention
				X						MHLN6918_	Sec Interface Board 3 Day Key Retention
					X					HKN1018_	Handset/Hangup Normal Armoured Cable
						X				HLN1457_	Handset/Hangup (Hangup Cup)
							X			HKN1017_	Handset/Hangup Coiled Cable
								X		HMN4089_	Visor Mic Remote Mount
									X	HMN1090_	Std Palm Mic GCAI
									X	HMN1087_	Gooseneck PTT
									X	HMN4079_	Keypad Microphone
			X	X						0310907A20	Screw M3 x 0.5 x 10
			X	X						2685498E02	Shield

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

**ASTRO XTL 5000 O5 UHF Range 1 100 Watt Model Chart (Cont.)**

<b>M20QTM9PW1AN</b>													
<b>Option</b>										<b>Description</b>			
W688AP										ADD: External Emergency Pushbutton			
W81AL										ADD: Key Lock Mount			
W116AN										ADD: External Alarm and Relay Cable			
W591AP										ADD: Auxiliary Switch Panel			
B18CL										ADD: Auxiliary Spkr Spectra 5 Watt			
W432AE										ADD: External 13 Watt Speaker			
G425AA										ADD: Antenna 1/4 Wave Whip 380-420 MHz			
G426AA										ADD: Antenna 1/4 Wave Whip 450-470 MHz			
G427AA										ADD: Antenna 3.5 dB 380-420 MHz			
G428AA										ADD: Antenna 3.5 dB 450-470 MHz			
G429AA										ADD: Antenna 5.0 dB 380-420 MHz			
G430AA										ADD: Antenna 5.0 dB 450-470 MHz			
G431AA										ADD: Antenna Wideband 380-470 MHz			
										<b>Item No.</b>		<b>Description</b>	
X										HLN5131_		Emergency Button	
	X									HLN6372_		Keylock Mount	
		X								HLN6969_		External Alarm Kit	
		X								HKN4258_		Cable Relay	
			X							HLN1196_		Auxiliary Switch Panel	
				X						HSN4031_		External 7.5 Watt Speaker	
					X					HSN4032_		External 13 Watt Speaker	
						X				HAE4003_		Antenna, 1/4 Wave 450-470 MHz	
							X			HAE4011_		Antenna, Roof Top 3.5 dB	
								X		HAE6010_		Antenna, 3.5 dB Gain 380-433 MHz	
									X	HAE6011_		Antenna, 5.0 dB Gain 380-433 MHz	
					X					HAE6012_		Antenna, 1/4 Wave Whip 380-433 MHz	
									X	HAE6013_		Antenna, Wideband 2.0 dB Gain 380-470 MHz	
									X	RAE4014ARB		Antenna, 5.0 dB 450-470 MHz	

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

## ASTRO XTL 5000 O5 UHF Range 2 10-40 Watt Model Chart

M20SSM9PW1AN													
Option										Description			
G66AD										ADD: Dash Mount			
G67AP										ADD: Mid Remote Mount			
G67AR										ADD: Remote Mount, No Control Head			
G582AA										ADD: Remote Mount Cable 40 meters (131 ft)			
G879AA										ADD: Remote Mount Cable 35 meters (115 ft)			
G607AA										ADD: Remote Mount Cable 23 meters (75 ft)			
G609AA										ADD: Remote Mount Cable 15 meters (50 ft)			
G610AA										ADD: Remote Mount Cable 10 meters (30 ft)			
G628AA										INT: Remote Mount Cable 5 meters (17 ft)			
G618AA										ADD: Remote Mount Cable 3 meters (10 ft)			
G442AB										ADD: XTL 5000 Control Head			
G927AA										INT: Connector Remote Mount			
										Item No.		Description	
		X	X							HKN4192_		Mobile Power Cable HiPower 20 ft	
		X								HKN6186_		Trunnion, Control Head Remote Mount	
		X								HKN6188_		Cable, Control Head Power and Speaker	
		X	X							HKN6190_		Cable, Front Remote Flex Assy for Transceiver	
		X								HKN6191_		Cable, Rear Remote Flex Assy for Control Head	
	X									HKN6192_		Cable, CH Flex Assy (Dash)	
		X	X							HLN1454_		Remote Assy, Radio End	
	X	X	X							HLN6861_		Hardware Std Install	
	X									HKN4191_		Mobile Power Cable HiPower	
		X								HLN6954_		Cover, Dust, Kit	
	X	X	X							HLN6970_		Wing Screw Torque Tool Kit	
	X		X							HHN4048_		Hardware Kit, Transceiver Attachment	
				X						HKN6164_		Remote Mount Cable 40 meters (131 ft)	
					X					HKN6165_		Remote Mount Cable 35 meters (115 ft)	
						X				HKN6166_		Remote Mount Cable 23 meters (75 ft)	
							X			HKN6167_		Remote Mount Cable 15 meters (50 ft)	
								X		HKN6168_		Remote Mount Cable 10 meters (30 ft)	
									X	HKN6169_		Remote Mount Cable 5 meters (17 ft)	
										X		Remote Mount Cable 3 meters (10 ft)	
	X		X							HLN6863_		Accessory Connector	
										X	HLN6961_	Accessory Connector Remote Mount	
										X	HLN1467_	Control Head, XTL 5000	
X										HUE4042_		Tanapa UHF R2 45W	
		X								HLN1468_		Control Head, Remote Assembly	
	X									1515048C01		Dust Cover	
	X									1585245E02		Radio Housing	
		X								0364332H02		M3 x 5 Screw	
	X									3285471E01		Seal Headbridge	

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

**ASTRO XTL 5000 O5 UHF Range 2 10-40 Watt Model Chart (Cont.)**

<b>M20SSM9PW1AN</b>														
<b>Option</b>										<b>Description</b>				
G159AH										ADD: XTL Encryption UCM HW 30 Sec Key				
G159AJ										ADD: XTL Encryption UCM HW 3 Day Sec Key Ret				
W874AA										ADD: Handset/Hangup Armoured Cable (GCAI)				
G874AA										ADD: Handset/Hangup (GCAI)				
G876AA										ADD: Hangup/Cradle w/Coiled CBL, GCAI				
W872AA										ADD: Visor Mic Standard				
W22AW										ADD: STD Palm Mic GCAI				
G233AC										ADD: Gooseneck PTT Millennium				
W20BX										ALT: Keypad Microphone				
W382AH										ALT: Control Station Palm Microphone				
W665BE										ADD: Control Station Base Mount				
G91AB										ADD: Control Station Power Supply				
W688AP										ADD: External Emergency Pushbutton				
W81AL										ADD: Key Lock Mount				
										<b>Item No.</b>		<b>Description</b>		
X										MHLN6919_		Secure Interface Board 30 Sec Key Retention		
	X									MHLN6918_		Secure Interface Board 3 Day Key Retention		
		X								HKN1018_		Handset/Hangup Normal Armoured Cable		
			X							HLN1457_		Handset/Hangup (Hangup Cup)		
				X						HKN1017_		Handset/Hangup Coiled Cable		
					X					HMN4089_		Visor Mic Remote Mount		
						X				HMN1090_		Std Palm Mic GCAI		
							X			HMN1087_		Gooseneck PTT		
								X		HMN4079_		Keypad Microphone		
									X	HMN1088_		Control Station Desk Microphone		
									X	HLN6042_		Control Station Mount		
									X	HPN4007_		Power Supply		
									X	HLN6188_		Emergency Pushbutton		
									X	HLN6372_		Keylock Mount		
									X	HLN5131_		Emergency Button		
								X		HLN6047_		Hardware Installation Base Tray		
X	X									0310907A20		Screw M3 x 0.5 x 10		
X	X									2685498E02		Shield		
								X		6880101W87		Spectra Controller Station Instructor Manual		
								X		6880102W93		Spectra Maxtrac Controller Base Manual		

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

## ASTRO XTL 5000 O5 UHF Range 2 10-40 Watt Model Chart (Cont.)

M20SSM9PW1AN											
Option										Description	
W116AN										ADD: External Alarm and Relay Cable	
W591AP										ADD: Auxiliary Switch Panel	
B18CL										ADD: Auxiliary Spkr Spectra 5 Watt	
W432AE										ADD: External 13 Watt Speaker	
G425AA										ADD: Antenna 1/4 Wave Whip 380-420 MHz	
G426AA										ADD: Antenna 1/4 Wave Whip 450-470 MHz	
G427AA										ADD: Antenna 3.5 dB 380-420 MHz	
G428AA										ADD: Antenna 3.5 dB 450-470 MHz	
G429AA										ADD: Antenna 5.0 dB 380-420 MHz	
G430AA										ADD: Antenna 5.0 dB 450-470 MHz	
G431AA										ADD: Antenna Wideband 380-470 MHz	
										Item No.	Description
X										HLN6969_	External Alarm Kit
X										HKN4258_	Cable Relay
	X									HLN1196_	Auxiliary Switch Panel
		X								HSN4031_	External 7.5 Watt Speaker
			X							HSN4032_	External 13 Watt Speaker
				X						HAE4003_	Antenna, 1/4 Wave 450-470 MHz
					X					HAE4011_	Antenna, Roof Top 3.5 dB
						X				HAE6010_	Antenna, 3.5 dB Gain 380-433 MHz
							X			HAE6011_	Antenna, 5.0 dB Gain 380-433 MHz
				X						HAE6012_	Antenna, 1/4 Wave Whip 380-433 MHz
								X		HAE6013_	Antenna, Wideband 2.0 dB Gain 380-470 MHz
								X		RAE4014ARB	Antenna, 5.0 dB 450-470 MHz

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

## ASTRO XTL 5000 O5 700-800 MHz 10-35 Watt Model Chart

M20URM9PW1AN												
Option										Description		
G66AD										ADD: Dash Mount		
G67AP										ADD: Mid Remote Mount		
G67AR										ADD: Remote Mount, No Control Head		
G582AA										ADD: Remote Mount Cable 40 meters (131 ft)		
G879AA										ADD: Remote Mount Cable 35 meters (115 ft)		
G607AA										ADD: Remote Mount Cable 23 meters (75 ft)		
G609AA										ADD: Remote Mount Cable 15 meters (50 ft)		
G610AA										ADD: Remote Mount Cable 10 meters (30 ft)		
G628AA										INT: Remote Mount Cable 5 meters (17 ft)		
G618AA										ADD: Remote Mount Cable 3 meters (10 ft)		
G442AB										ADD: XTL 5000 Control Head		
G927AA										INT: Connector Remote Mount		
										Item No.	Description	
		X	X							HKN4192_	Mobile Power Cable HiPower 20 ft	
		X								HKN6186_	Trunnion, Control Head Remote Mount	
		X								HKN6188_	Cable, Control Head Power and Speaker	
		X	X							HKN6190_	Cable, Front Remote Flex Assy for Transceiver	
		X								HKN6191_	Cable, Rear Remote Flex Assy for Control Head	
	X									HKN6192_	Cable, Control Head Flex Assy (Dash)	
		X	X							HLN1454_	Remote Assy, Radio End	
	X	X	X							HLN6861_	Hardware Std Install	
	X									HKN4191_	Mobile Power Cable HiPower	
		X								HLN6954_	Cover, Dust, Kit	
	X	X	X							HLN6970_	Wing Screw Torque Tool Kit	
	X		X							HHN4048_	Hardware Kit, Transceiver Attachment	
				X						HKN6164_	Remote Mount Cable 40 meters (131 ft)	
					X					HKN6165_	Remote Mount Cable 35 meters (115 ft)	
						X				HKN6166_	Remote Mount Cable 23 meters (75 ft)	
							X			HKN6167_	Remote Mount Cable 15 meters (50 ft)	
								X		HKN6168_	Remote Mount Cable 10 meters (30 ft)	
									X	HKN6169_	Remote Mount Cable 5 meters (17 ft)	
									X	HKN6170_	Remote Mount Cable 3 meters (10 ft)	
	X		X							HLN6863_	Accessory Connector	
									X	HLN6961_	Accessory Connector Remote Mount	
									X	HLN1467_	Control Head, XTL 5000	
		X								HLN1468_	Control Head, Remote Mount	
X										HUF1291_	Tanapa 700-800 35W	
	X									1515048C01	Dust Cover	
	X									1585245E02	Radio Housing	
		X								0364332H02	M3 x 5 Screw	
		X								3285471E01	Seal Headbridge	

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)



## ASTRO XTL 5000 O5 700-800 MHz 10-35 Watt Model Chart (Cont.)

M20URM9PW1AN														
Option										Description				
G159AH										ADD: XTL Encryption UCM HW 30 Sec Key				
G159AJ										ADD: XTL Encryption UCM HW 3 Day Sec Key Ret				
W874AA										ADD: Handset/Hangup Armoured Cable (GCAI)				
G874AA										ADD: Handset/Hangup (GCAI)				
G876AA										ADD: Hangup/Cradle w/Coiled CBL, GCAI				
W872AA										ADD: Visor Mic Standard				
W22AW										ADD: STD Palm Mic GCAI				
G233AC										ADD: Gooseneck PTT Millennium				
W20BX										ALT: Keypad Microphone				
W382AH										ALT: Control Station Palm Microphone				
W665BE										ADD: Control Station Base Mount				
G91AB										ADD: Control Station Power Supply				
W688AP										ADD: External Emergency Pushbutton				
W81AL										ADD: Key Lock Mount				
										Item No.		Description		
X										MHLN6919_	Secure Interface Board 30 Sec Key Retention			
	X									MHLN6918_	Secure Interface Board 3 Day Key Retention			
		X								HKN1018_	Handset/Hangup Normal Armoured Cable			
			X							HLN1457_	Handset/Hangup (Hangup Cup)			
				X						HKN1017_	Handset/Hangup Coiled Cable			
					X					HMN4089_	Visor Mic Remote Mount			
						X				HMN1090_	Std Palm Mic GCAI			
							X			HMN1087_	Gooseneck PTT			
								X		HMN4079_	Keypad Microphone			
									X	HMN1088_	Control Station Desk Microphone			
									X	HLN6042_	Control Station Mount			
									X	HPN4007_	Power Supply			
									X	HLN6372_	Keylock Mount			
									X	HLN5131_	Emergency Button			
						X				HLN6047_	Hardware Installation Base Tray			
X	X									0310907A20	Screw M3 x 0.5 x 10			
X	X									2685498E02	Shield			
								X		6880101W87	Spectra Controller Station Instructor Manual			
								X		6880102W93	Spectra Maxtrac Controller Base Manual			

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

**ASTRO XTL 5000 O5 700-800 MHz 10-35 Watt Model Chart (Cont.)**

<b>M20URM9PW1AN</b>									
<b>Option</b>							<b>Description</b>		
						W116AN	ADD: External Alarm and Relay Cable		
						W591AP	ADD: Auxiliary Switch Panel		
						B18CL	ADD: Auxiliary Spkr Spectra 5 Watt		
						W432AE	ADD: External 13 Watt Speaker		
						W484AD	ALT: Antenna 3 dB Gain 762-870 MHz		
						G335AT	ADD: Antenna 1/4 Wave 762-870 MHz		
						G174AA	ADD: Antenna 3 dB Low Profile 762-870 MHz		
						G175AA	ADD: Antenna 3 dB Elvat Feed 762-870 MHz		
							<b>Item No.</b>	<b>Description</b>	
	X						HLN6969_	External Alarm Kit	
	X						HKN4258_	Cable Relay	
		X					HLN1196_	Auxiliary Switch Panel	
			X				HSN4031_	External 7.5 Watt Speaker	
				X			HSN4032_	External 13 Watt Speaker	
					X		HAF4013_	Antenna, 3 dB Low Profile 762-870 MHz	
						X	HAF4014_	Antenna, 3 dB Elevated Feed 762-870 MHz	
					X		HAF4016_	1/4 Wave Antenna 762-870 MHz	
				X			HAF4017_	Antenna, 3 dB Collinear 762-870 MHz	

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

## ASTRO XTL 5000 O5 700-800 MHz 10-35 Watt (Reband) Model Chart

M20URM9PW1AN													
Option										Description			
G66AD										ADD: Dash Mount			
G66AG										ADD: Dash Mount			
G67AP										ADD: Mid Remote Mount			
G67AV										ADD: Remote Mount			
G582AA										ADD: Remote Mount Cable 40 meters (131 ft)			
G879AA										ADD: Remote Mount Cable 35 meters (115 ft)			
G607AA										ADD: Remote Mount Cable 23 meters (75 ft)			
G609AA										ADD: Remote Mount Cable 15 meters (50 ft)			
G610AA										ADD: Remote Mount Cable 10 meters (30 ft)			
G628AA										INT: Remote Mount Cable 5 meters (17 ft)			
G618AA										ADD: Remote Mount Cable 3 meters (10 ft)			
										Item No.		Description	
		X	X							HKN4192_		Mobile Power Cable HiPower 20 ft	
		X	X							HKN6186_		Trunnion, Control Head Remote Mount	
		X	X							HKN6188_		Cable, Control Head Power and Speaker	
		X								HKN6190_		Cable, Front Remote Flex Assy for Transceiver	
		X								HKN6191_		Cable, Rear Remote Flex Assy for Control Head	
X										HKN6192_		Cable, Control Head Flex Assy (Dash)	
		X								HLN1454_		Remote Assy, Radio End	
X	X	X	X							HLN6861_		Hardware Std Install	
X	X									HKN4191_		Mobile Power Cable HiPower	
		X	X							HLN6954_		Cover, Dust, Kit	
X		X								HLN6970_		Wing Screw Torque Tool Kit	
X										HHN4048_		Hardware Kit, Transceiver Attachment	
				X						HKN6164_		Remote Mount Cable 40 meters (131 ft)	
					X					HKN6165_		Remote Mount Cable 35 meters (115 ft)	
						X				HKN6166_		Remote Mount Cable 23 meters (75 ft)	
							X			HKN6167_		Remote Mount Cable 15 meters (50 ft)	
								X		HKN6168_		Remote Mount Cable 10 meters (30 ft)	
									X	HKN6169_		Remote Mount Cable 5 meters (17 ft)	
									X	HKN6170_		Remote Mount Cable 3 meters (10 ft)	
X	X									HLN6863_		Accessory Connector	
		X								HLN1468_		Control Head, Remote Assembly	
X	X									1515048C01		Dust Cover	
X										1585245E02		Radio Housing	
		X								0364332H02		M3 x 5 Screw	
		X								3285471E01		Seal Headbridge	

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

## ASTRO XTL 5000 O5 700-800 MHz 10-35 Watt (Reband) Model Chart (Cont.)

M20URM9PW1AN																	
Option										Description							
G927AA										INT: Connector Remote Mount							
G442AC										ADD: XTL 5000 Control Head RB							
G442AE										ADD: XTL 5000 Control Head Dash UCM RB							
G159AH										ADD: XTL Encryption UCM HW 30 Sec Key							
G159AJ										ADD: XTL Encryption UCM HW 3 Day Sec Key Ret							
W874AA										ADD: Handset/Hangup Armoured Cable (GCAI)							
G874AA										ADD: Handset/Hangup (GCAI)							
G876AA										ADD: Hangup/Cradle w/Coiled CBL, GCAI							
W872AA										ADD: Visor Mic Standard							
W22AW										ADD: STD Palm Mic GCAI							
G233AC										ADD: Gooseneck PTT Millennium							
W20BX										ALT: Keypad Microphone							
W382AH										ALT: Control Station Palm Microphone							
W665BE										ADD: Control Station Base Mount							
										Item No.		Description					
	X									HLN6961_	Accessory Connector Remote Mount						
		X								PMUF1266_	Control Head with CHIB						
			X							HLN1467_	Control Head						
				X						MHLN6919_	Secure Interface Board 30 Sec Key Retention						
					X					MHLN6918_	Secure Interface Board 3 Day Key Retention						
						X				HKN1018_	Handset/Hangup Normal Armoured Cable						
							X			HLN1457_	Handset/Hangup (Hangup Cup)						
								X		HKN1017_	Handset/Hangup Coiled Cable						
									X	HMN4089_	Visor Mic Remote Mount						
									X	HMN1090_	Std Palm Mic GCAI						
										X	HMN1087_	Gooseneck PTT					
											X	HMN4079_	Keypad Microphone				
												X	HMN1088_	Control Station Desk Microphone			
											X	HLN6042_	Control Station Mount				
											X	HLN6047_	Hardware Installation Base Tray				
				X	X							0310907A20	Screw M3 x 0.5 x 10				
				X	X							2685498E02	Shield				
										X	6880101W87	Spectra Controller Station Instructor Manual					
										X	6880102W93	Spectra Maxtrac Controller Base Manual					

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

(Chart Continued on the next page)

## ASTRO XTL 5000 O5 700-800 MHz 10-35 Watt (Reband) Model Chart (Cont.)

M20URM9PW1AN												
Option										Description		
G91AB										ADD: Control Station Power Supply		
W688AP										ADD: External Emergency Pushbutton		
W81AL										ADD: Key Lock Mount		
W116AN										ADD: External Alarm and Relay Cable		
W591AP										ADD: Auxiliary Switch Panel		
B18CL										ADD: Auxiliary Spkr Spectra 5 Watt		
W432AE										ADD: External 13 Watt Speaker		
W484AD										ALT: Antenna 3 dB Gain 762-870 MHz		
G335AT										ADD: Antenna 1/4 Wave 762-870 MHz		
G174AA										ADD: Antenna 3 dB Low Profile 762-870 MHz		
G175AA										ADD: Antenna 3 dB Elvat Feed 762-870 MHz		
										Item No.	Description	
X										HPN4007_	Power Supply	
	X									HLN5131_	Emergency Button	
		X								HLN6372_	Keylock Mount	
			X							HLN6969_	External Alarm Kit	
			X							HKN4258_	Cable Relay	
				X						HLN1196_	Auxiliary Switch Panel	
					X					HSN4031_	External 7.5 Watt Speaker	
						X				HSN4032_	External 13 Watt Speaker	
								X		HAF4013_	Antenna, 3 dB Low Profile 762-870 MHz	
									X	HAF4014_	Antenna, 3 dB Elevated Feed 762-870 MHz	
							X			HAF4016_	1/4 Wave Antenna 762-870 MHz	
						X				HAF4017_	Antenna, 3 dB Collinear 762-870 MHz	

X = Item Included

\_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

## VHF Radio Specifications

GENERAL		RECEIVER	TRANSMITTER
<b>FCC Designations:</b>	<b>AZ492FT3806</b> <b>AZ492FT3808</b>	<b>Frequency Range:</b> 136–174 MHz	<b>Frequency Range:</b> 136–174 MHz
<b>Temperature Range:</b>		<b>Channel Spacing:</b> 12.5 kHz/25 kHz/30 kHz	<b>Rated Output Power:</b>
Operating:	–30°C to +60°C	<b>Input Impedance:</b> 50 Ohm	Low-Power Radio: 25 Watt
Storage:	–55°C to +85°C	<b>Frequency Separation:</b> Full Bandsplit	Mid-Power Radio: 50 Watt
<b>Power Supply:</b> 12 Vdc Negative Ground Only		<b>Sensitivity:</b> (per EIA spec. RS204C) <b>With pre-amplifier</b>	High-Power Radio: 100 Watt
<b>Battery Drain:</b> (Maximum)		<b>20 dB Quieting:</b> (25 kHz Channel Spacing): 0.25 µV	<b>Channel Spacing:</b> 12.5 kHz, 25 kHz or 30 kHz
<b>50 Watt:</b>		<b>12 dB SINAD:</b> (25 kHz Channel Spacing): 0.20 µV	<b>Output Impedance:</b> 50 Ohm
Standby @ 13.8 V:	0.85 A	<b>Without pre-amplifier</b>	<b>Frequency Separation:</b> Full Bandsplit
Receive at Rated Audio @ 13.8 V:	3.2 A	<b>20 dB Quieting:</b> (25 kHz Channel Spacing): 0.4 µV	<b>Frequency Stability:</b>
Transmit @ Rated Power:		<b>12 dB SINAD:</b> (25 kHz Channel Spacing): 0.3 µV	(–30° to +60°C; 25°C Ref.): ±2 ppm
15 W	8.0 A		<b>Modulation Limiting:</b>
50 W	13.0 A		25 kHz Channel Spacing: ±5.0 kHz
<b>110 Watt:</b>			12.5 kHz Channel Spacing: ±2.5 kHz
Standby @ 13.8 V:	0.85 A	<b>Intermodulation:</b> (per EIA Specifications)	<b>Frequency Deviation for (C4FM):</b>
Receive at Rated Audio @ 13.8 V:	3.2 A	<b>With pre-amplifier</b>	12.5 kHz Digital Channel: ±2.8 kHz
Transmit @ Rated Power:		(Measured in the Analog Mode): 80 dB	<b>FM Hum and Noise:</b>
100 W	20.0 A	<b>Without pre-amplifier</b>	25 kHz Channel Spacing: 50 dB
<b>Dimensions (H x W x D)*</b>		(Measured in the Analog Mode): 85 dB	12.5 kHz Channel Spacing: 40 dB
Remote-Mount Control Head:	2.4" x 7.0" x 3.0" (61 mm x 178 mm x 76 mm)	<b>Digital Sensitivity:</b>	<b>Emission (Conduct/Radiated):</b> –85 dBc/–20dBm
Low/Mid Power Remote Transceiver:	2.4" x 7.0" x 8.7" (61 mm x 178 mm x 221 mm)	<b>With pre-amplifier</b>	<b>Audio Sensitivity:</b>
High Power Transceiver:	2.765" x 8.08" x 12.31" (70.2 mm x 205.2 mm x 312.7 mm)	1% BER (12.5 kHz channel): 0.25 µV	(For 60% Max. Deviation at 1 kHz): 0.08V ±3 dB
High Power Quick Release Transceiver:	2.7" x 8.1" x 12.3" (67 mm x 205 mm x 312 mm)	5% BER (12.5 kHz channel): 0.20 µV	<b>Audio Response:</b>
Dash-Mount Radio:	2.4" x 7.0" x 9.4" (61 mm x 178 mm x 239 mm)	<b>Without pre-amplifier</b>	(Measured in the Analog Mode)
Speaker:	5.5" x 5.5" x 2.5" (139.7 mm x 139.7 mm x 63.5 mm)	1% BER (12.5 kHz channel): 0.4 µV	(6 dB/Octave Pre-Emphasis 300 to 3000Hz):
<b>Weight:</b>		5% BER (12.5 kHz channel): 0.3 µV	+1, –3 dB
Remote-Mount Control Head:	1.1 lb (483g)	<b>Selectivity:</b> (per EIA Specifications)	<b>Audio Distortion:</b>
Low/Mid Power Remote Transceiver:		(Measured in the Analog Mode)	(For 60% Max. Deviation at 1 kHz): 2% per EIA
High Power Transceiver:	4.7 lbs (2152g)	30 kHz Channel Spacing: –90 dB	<b>Emissions Designators:</b>
High Power Quick Release Transceiver:	8.3 lbs (3765g)	12.5 kHz Channel Spacing: –70 dB	8K10F1E, 11K0F3E, 15K0F2D, 16K0F3E,
Dash-Mount Radio:	8.8 lbs (3992g)	<b>Intermodulation:</b> (per EIA Specifications)	20K0F1E, 15K0F1D, 11K0F1D, and 11K0F2D
Speaker:	5.0 lbs (2276g)	(Measured in the Analog Mode): –80 dB	
	1.5 lbs (680g)	<b>Spurious Rejection:</b> 90 dB	
		<b>Frequency Stability:</b>	
		(–30° to +60°C; 25°C Reference.): ±2 ppm	
		<b>Audio Output:</b> (per EIA Specifications)	
		(Measured in the Analog Mode at Less than 3% Distortion):	
		7.5W (8 ohm Speaker)	
		13W (3.2 ohm Speaker)	

\*All dimensions and weights are shown excluding any mounting hardware or cables.

Specifications subject to change without notice.

All measurements are taken in the test mode at 25 kHz channel spacing except where indicated.

## UHF Range 1 Radio Specifications

GENERAL		RECEIVER	TRANSMITTER
<b>FCC Designations:</b>	<b>AZ492FT4862</b> <b>AZ492FT4870</b>	<b>Frequency Range:</b> Range 1: 380–470 MHz	<b>Frequency Range:</b> Range 1: 380–470 MHz
<b>Temperature Range:</b> Operating: –30°C to +60°C Storage: –51°C to +85°C		<b>Channel Spacing:</b> 12.5 kHz/25 kHz	<b>Rated Output Power:</b> Low-Power Radio: 25 Watt Mid-Power Radio: 50 Watt High-Power Radio: 100 Watt
<b>Power Supply:</b> 12 Vdc Negative Ground Only		<b>Input Impedance:</b> 50 Ohm	<b>Channel Spacing:</b> 12.5 kHz or 25 kHz
<b>Battery Drain:</b> (Maximum) <b>40 Watt:</b> Standby @ 13.8 V: 0.85 A Receive at Rated Audio @ 13.8 V: 3.2 A Transmit @ Rated Power: 15 W 8.0 A 40 W 11.0 A		<b>Frequency Separation:</b> Full Bandsplit	<b>Output Impedance:</b> 50 Ohm
		<b>Sensitivity:</b> (per EIA spec. RS204C) <b>With pre-amplifier</b> <b>20 dB Quieting:</b> (25 kHz Channel Spacing): 0.25 µV <b>12 dB SINAD:</b> (25 kHz Channel Spacing): 0.20 µV	<b>Frequency Separation:</b> Ref Above Bandsplit
		<b>Without pre-amplifier</b> <b>20 dB Quieting:</b> (25 kHz Channel Spacing): 0.4 µV <b>12 dB SINAD:</b> (25 kHz Channel Spacing): 0.3 µV	<b>Frequency Stability:</b> (–30° to +60°C; 25°C Ref.): ±2 ppm
<b>110 Watt:</b> Standby @ 13.8 V: 0.85 A Receive at Rated Audio @ 13.8 V: 3.2 A Transmit @ Rated Power: 100 W 24.0 A		<b>Intermodulation:</b> (per EIA Specifications) <b>With pre-amplifier</b> (Measured in the Analog Mode): 80 dB <b>Without pre-amplifier</b> (Measured in the Analog Mode): 85 dB	<b>Modulation Limiting:</b> 25 kHz Channel Spacing: ±5.0 kHz 12.5 kHz Channel Spacing: ±2.5 kHz
<b>Dimensions (H x W x D)*</b> Remote-Mount Control Head: 2.4" x 7.0" x 3.0" (61 mm x 178 mm x 76 mm) Low/Mid Power Remote Transceiver: 2.4" x 7.0" x 8.7" (61 mm x 178 mm x 221 mm) High Power Transceiver: 2.765" x 8.08" x 12.31" (70.2 mm x 205.2 mm x 312.7 mm) High Power Quick Release Transceiver: 2.7" x 8.1" x 12.3" (67 mm x 205 mm x 312 mm) Dash-Mount Radio: 2.4" x 7.0" x 9.4" (61 mm x 178 mm x 239 mm) Speaker: 5.5" x 5.5" x 2.5" (139.7 mm x 139.7 mm x 63.5 mm)		<b>Digital Sensitivity:</b> <b>With pre-amplifier</b> 1% BER (12.5 kHz channel): 0.25 µV 5% BER (12.5 kHz channel): 0.20 µV <b>Without pre-amplifier</b> 1% BER (12.5 kHz channel): 0.4 µV 5% BER (12.5 kHz channel): 0.3 µV	<b>Frequency Deviation for (C4FM):</b> 12.5 kHz Digital Channel: ±2.8 kHz
		<b>Selectivity:</b> (per EIA Specifications) (Measured in the Analog Mode) 25 kHz Channel Spacing: –82 dB 12.5 kHz Channel Spacing: –75 dB	<b>FM Hum and Noise:</b> 25 kHz Channel Spacing: 45 dB 12.5 kHz Channel Spacing: 40 dB
<b>Weight:</b> Remote-Mount Control Head: 1.1 lb (483g) Low/Mid Power Remote Transceiver: 4.8 lbs (2169g) High Power Transceiver: 8.3 lbs (3765g) High Power Quick Release Transceiver: 8.8 lbs (3992g) Dash-Mount Radio: 5.1 lbs (2293g) Speaker: 1.5 lbs (680g)		<b>Spurious Rejection:</b> 90 dB	<b>Emission (Conduct/Radiated):</b> –85 dBc/-20dBm
		<b>Frequency Stability:</b> (–30° to +60°C; 25°C Reference): ±2 ppm	<b>Audio Sensitivity:</b> (For 60% Max. Deviation at 1 kHz): 0.08V ±3 dB
<i>*All dimensions and weights are shown excluding any mounting hardware or cables.</i>		<b>Audio Output:</b> (per EIA Specifications) (Measured in the Analog Mode at Less than 3% Distortion): 7.5 W (8 ohm Speaker) 13W (3.2 ohm Speaker)	<b>Audio Response:</b> (Measured in the Analog Mode) (6 dB/Octave Pre-Emphasis 300 to 3000Hz): +1, –3 dB
			<b>Audio Distortion:</b> (For 60% Max. Deviation at 1 kHz): 2% per EIA
			<b>Emissions Designators:</b> 8K10F1E, 11K0F3E, 15K0F2D, 16K0F3E, 20K0F1E, 15K0F1D, 11K0F1D, and 11K0F2D

*Specifications subject to change without notice.*

*All measurements are taken in the test mode at 25 kHz channel spacing except where indicated.*

## UHF Range 2 Radio Specifications

GENERAL		RECEIVER	TRANSMITTER
<b>FCC Designations:</b>	<b>AZ492FT4867</b>	<b>Frequency Range:</b> Range 2: 450–520 MHz	<b>Frequency Range:</b> Range 2: 450–520 MHz
<b>Temperature Range:</b> Operating: –30°C to +60°C Storage: –51°C to +85°C		<b>Channel Spacing:</b> 12.5 kHz/25 kHz	<b>Rated Output Power:</b> Mid-Power Radio: 45 Watt 450–500 MHz 40 Watt 500–512 MHz 25 Watt 512–520 MHz
<b>Power Supply:</b> 12 Vdc Negative Ground Only		<b>Input Impedance:</b> 50 Ohm	
<b>Battery Drain:</b> (Maximum)		<b>Frequency Separation:</b> Full Bandsplit	<b>Channel Spacing:</b> 12.5 kHz/25 kHz
<b>45 Watt:</b>		<b>Sensitivity:</b> (per EIA spec. RS204C) <b>With pre-amplifier</b> <b>20 dB Quieting:</b> (25 kHz Channel Spacing): 0.25 µV <b>12 dB SINAD:</b> (25 kHz Channel Spacing): 0.20 µV <b>Without pre-amplifier</b> <b>20 dB Quieting:</b> (25 kHz Channel Spacing): 0.4 µV <b>12 dB SINAD:</b> (25 kHz Channel Spacing): 0.3 µV	<b>Output Impedance:</b> 50 Ohm <b>Frequency Separation:</b> Ref Above Bandsplit <b>Frequency Stability:</b> (–30° to +60°C; 25°C Ref.): ±2 ppm <b>Modulation Limiting:</b> 25 kHz Channel Spacing: ±5.0 kHz 12.5 kHz Channel Spacing: ±2.5 kHz <b>Frequency Deviation for (C4FM):</b> 12.5 kHz Digital Channel: ±2.8 kHz <b>FM Hum and Noise:</b> 25 kHz Channel Spacing: 45 dB 12.5 kHz Channel Spacing: 40 dB <b>Emission (Conduct/Radiated):</b> –85 dBc/–20dBm <b>Audio Sensitivity:</b> (For 60% Max. Deviation at 1 kHz): 0.08V ±3 dB <b>Audio Response:</b> (Measured in the Analog Mode) (6 dB/Octave Pre-Emphasis 300 to 3000Hz): +1, –3 dB <b>Audio Distortion:</b> (For 60% Max. Deviation at 1 kHz): 2% per EIA <b>Emissions Designators:</b> 8K10F1E, 11K0F3E, 15K0F2D, 16K0F3E, 20K0F1E, 15K0F1D, 11K0F1D, and 11K0F2D
<b>Standby @ 13.8 V:</b> 0.85 A <b>Receive at Rated Audio @ 13.8 V:</b> 3.2 A <b>Transmit @ Rated Power:</b> 15 W 8.0 A 45 W 11.0 A			
<b>Dimensions (H x W x D)*</b> Remote-Mount Control Head: 2.4" x 7.0" x 3.0" (61 mm x 178 mm x 76 mm) Low/Mid Power Remote Transceiver: 2.4" x 7.0" x 8.7" (61 mm x 178 mm x 221 mm) Dash-Mount Radio: 2.4" x 7.0" x 9.4" (61 mm x 178 mm x 239 mm) Speaker: 5.5" x 5.5" x 2.5" (139.7 mm x 139.7 mm x 63.5 mm)			
<b>Weight:</b> Remote-Mount Control Head: 1.1 lb (483g) Low/Mid Power Remote Transceiver: 4.8 lbs (2169g) Dash-Mount Radio: 5.1 lbs (2293g) Speaker: 1.5 lbs (680g)			
<b>*All dimensions and weights are shown excluding any mounting hardware or cables.</b>			

Specifications subject to change without notice.

All measurements are taken in the test mode at 25 kHz channel spacing except where indicated.



## 700–800 MHz Radio Specifications

GENERAL	RECEIVER	TRANSMITTER
<b>FCC Designations:</b> AZ492FT5823  <b>Temperature Range:</b> Operating: –30° C to +60° C Storage: –40° C to +85° C  <b>Power Supply:</b> 12 Vdc Negative Ground Only  <b>Battery Drain:</b> (Maximum) <b>35 W:</b> Standby @ 13.8 V: 0.85 A Receive at Rated Audio @ 13.8 V: 3.2 A Transmit @ Rated Power: 15 W 8.0 A 35 W 12.0 A  <b>Dimensions (H x W x D)*</b> Remote-Mount Control Head: 2.4" x 7.0" x 3.0" (61 mm x 178 mm x 76 mm) Low/Mid Power Remote Transceiver: 2.4" x 7.0" x 8.7" (61 mm x 178 mm x 221 mm) Dash-Mount Radio: 2.4" x 7.0" x 9.4" (61 mm x 178 mm x 239 mm) Speaker: 5.5" x 5.5" x 2.5" (139.7 mm x 139.7 mm x 63.5 mm)  <b>Weight:</b> Remote-Mount Control Head: 1.1 lb (483g) Low/Mid Power Remote Transceiver: 5.2 lbs (2345g) Dash-Mount Radio: 5.2 lbs (2345g) Speaker: 1.5 lbs (680g)  *All dimensions and weights are shown excluding any mounting hardware or cables.	<b>Frequency Range:</b> 700 MHz Band: 764–776 MHz 800 MHz Band: 851–870 MHz  <b>Channel Spacing:</b> 12.5 kHz/20 kHz/25 kHz  <b>Input Impedance:</b> 50 ohm  <b>Frequency Separation:</b> Full Bandsplit  <b>Sensitivity:</b> <b>20 dB Quieting:</b> 25 kHz Channel Spacing: 0.30 µV <b>12 dB SINAD:</b> 25 kHz Channel Spacing: 0.25 µV  <b>Digital Sensitivity**:</b> 1% BER (12.5 kHz channel): 0.30 µV 5% BER (12.5 kHz channel): 0.25 µV  <b>Adjacent Channel Selectivity*:</b> 25 kHz Channel: 80 dB 12.5 kHz Channel: 65 dB  <b>Intermodulation*:</b> 80 dB  <b>Spurious Rejection*:</b> 90 dB  <b>Frequency Stability*:</b> (–30° to +60° C; 25° C Ref.): ±1.5 ppm  <b>Audio Output at 3% Distortion*:</b> 7.5 W (8 ohm Speaker) 13 W (3.2 ohm Speaker)	<b>Frequency Range:</b> <b>700 MHz Band:</b> Repeater Mode: 794–806 MHz Talkaround Mode: 764–776 MHz <b>800 MHz Band:</b> Repeater Mode: 806–825 MHz Talkaround Mode: 851–870 MHz  <b>Rated Output Power:</b> 764–806 MHz Band: 2***/30 W 806–870 MHz Band: 35 W  <b>Channel Spacing:</b> 12.5 kHz/20 kHz/25 kHz  <b>Output Impedance:</b> 50 ohm  <b>Frequency Separation:</b> Full Bandsplit  <b>Frequency Stability*:</b> (–30° to +60° C; 25° C Ref.): ±1.5 ppm  <b>Modulation Limiting*:</b> 25 kHz Channel Spacing: ±5.0 kHz 12.5 kHz Channel Spacing: ±2.5 kHz  <b>Frequency Deviation for (C4FM)**:</b> 12.5 kHz Digital Channel: ±2.8 kHz  <b>FM Hum and Noise*:</b> 20/25 kHz Channel: 40 dB 12.5 kHz Channel: 34 dB  <b>Emission (Conducted/Radiated):</b> –70 dBc/–20dBm and –85 dBc/–40dBm (GNSS)  <b>Audio Sensitivity*:</b> (For 60% Max. Deviation at 1 kHz): 0.08 V ±3 dB  <b>Audio Response*:</b> (6 dB/Octave Pre-Emphasis 300 to 3000 Hz): +1,–3 dB  <b>Audio Distortion*:</b> 2%  <b>Emissions Designators:</b> 8K10F1D, 8K10F1E, 11K0F3E, 16K0F3E, and 20K0F1E

Specifications subject to change without notice.

\* Measured in analog mode per TIA/EIA 603 under nominal conditions.

\*\* Measured in digital mode per TIA/EIA IS 102.CAAB.

\*\*\* 2 W. itinerant frequencies.

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# Chapter 1 Introduction

## 1.1 Notations Used in This Manual

Throughout the text in this publication, you will notice the use of note, caution, warning, and danger notations. These notations are used to emphasize that safety hazards exist, and due care must be taken and observed.

**NOTE:** An operational procedure, practice, or condition that is essential to emphasize.



CAUTION indicates a potentially hazardous situation which, if not avoided, might result in equipment damage.



**WARNING** indicates a potentially hazardous situation which, if not avoided, could result in death or injury.



**DANGER** indicates an imminently hazardous situation which, if not avoided, will result in death or injury.

## 1.2 Radio Description

The ASTRO Digital XTL 5000 mobile radio is Motorola's newest two-way mobile radio designed for your organization's most demanding needs. The XTL 5000 radio is available in the following frequency ranges and power levels.

*Table 1-1. XTL 5000 Radio Frequency Ranges and Power Levels*

Freq. Band	Bandwidth	Power Level
VHF	136–174 MHz	10–50 W variable
VHF 100W	136–174 MHz	25–100 W variable
UHF R1	380–470 MHz	10–40 W variable
UHF R1 100W	380–470 MHz	25–100 W variable
UHF R2	450–500 MHz 500–520 MHz	10–45 W variable 10–40 W variable
700–800 MHz	762–870 MHz	10–35 W variable (2 W itinerant)

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The ASTRO XTL 5000 radios are among the most sophisticated two-way radios available. They have a new robust design for radio users who need high performance, quality, and reliability in their daily communications. This new architecture provides the capability of supporting a multitude of legacy and advanced features resulting in a more cost-effective two-way radio communications solution.

Table 1-3 provides a description of basic features for the XTL 5000 control head.

*Table 1-2. O3 Control Head Basic Features*

Feature	XTL 5000
Display	4 lines being for Primary, Secondary, Tertiary and Menu line. Max primary text area character size (WxH):12 x 18 pixels. Max secondary and tertiary text are character size (WxH):10 x 15 pixels. Color LCD with 3 dimming levels; High, Low and Off.
Control Type	Push Button On/Off, Keypad Up/Down for Mode and Volume, Home Keypad Button, WAP keypad Button, 3 Menu Keypad Buttons and 4 way navigation pad.
Numeric Keypad	12 Keypad consisting of 1-9, 0, * and #.
Channel Capability	512
Remote Mount	Available
Dash Mount	Available
Dual Control Head	Future Feature
Motorcycle	Not Available

*Table 1-3. O5 Control Head Basic Features*

Feature	XTL 5000
Display	2 lines/14 character of text, 1 menu line, bit map Liquid-Crystal Display (LCD)
Control Type	Rotary Mode and Volume Control, Push Button On/Off
Numeric Keypad	Available with Keypad Microphone
Channel Capability	512
Remote Mount	Available
Dash Mount	Available
Dual Control Head	Future Feature
Motorcycle	Available

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## 1.3 FLASHport®

All ASTRO Digital XTL 5000 mobile radios are part of the FLASHport program and ship standard with a FLASH Electrically Erasable Programmable Read-Only Memory (EEPROM), which allows for feature and system upgrades. FLASHport Aftermarket Software is used to upgrade to the latest version of your System Enhancement Software Package, to upgrade to a different System Enhancement Software Package, or to order enhancements for existing ASTRO Digital XTL 5000 mobile radios in the field.

## 1.4 XTL 5000 O3/O5 Control Head Descriptions

The control head used with the XTL 5000 radio has microprocessor circuitry that operates the standard and optional features built into the system.

The following illustration shows a typical XTL 5000 control head.

### 1.4.1 XTL 5000 O3 Control Head

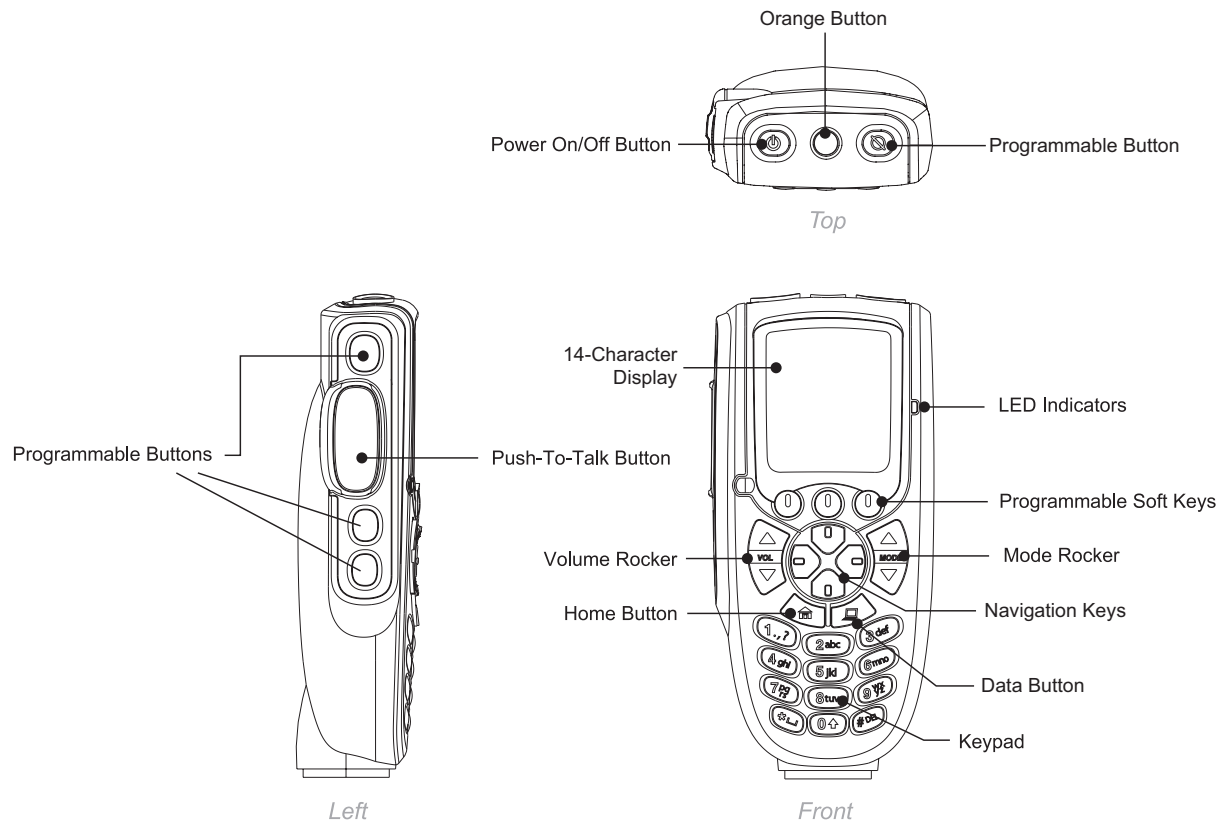


Figure 1-1. XTL 5000 O3 Control Head

### 1.4.2 XTL 5000 O3 Controls

- POWER ON/OFF BUTTON - Turns the radio on and off.
- ORANGE BUTTON - Programmed at the factory to activate the Emergency feature.
- TOP PROGRAMMABLE BUTTON - Buttons that can be custom programmed by system manager.
- PROGRAMMABLE SOFTKEYS - Field-programmable buttons.
- NAVIGATION KEYS - Used to scroll through menu items and selections.
- VOLUME ROCKER - Adjust the volume level up or down.
- MODE ROCKER - Scroll up or down through the list of available modes.
- HOME BUTTON- Used to exit all menu functions.
- WAP BUTTON - Unknown.
- NUMERIC KEYPAD - Features 12 keys and used to enter menus, scroll through a list of displayed options, and enter data.
- PUSH TO TALK BUTTON - Pressed to transmit on the displayed mode and released to receive.
- LED INDICATOR - Green/red light-emitting diode that indicates radio status as you operate various features.
- SIDE PROGRAMMABLE BUTTONS - Buttons that can be custom programmed by system manager.

### 1.4.3 XTL 5000 O5 Control Head

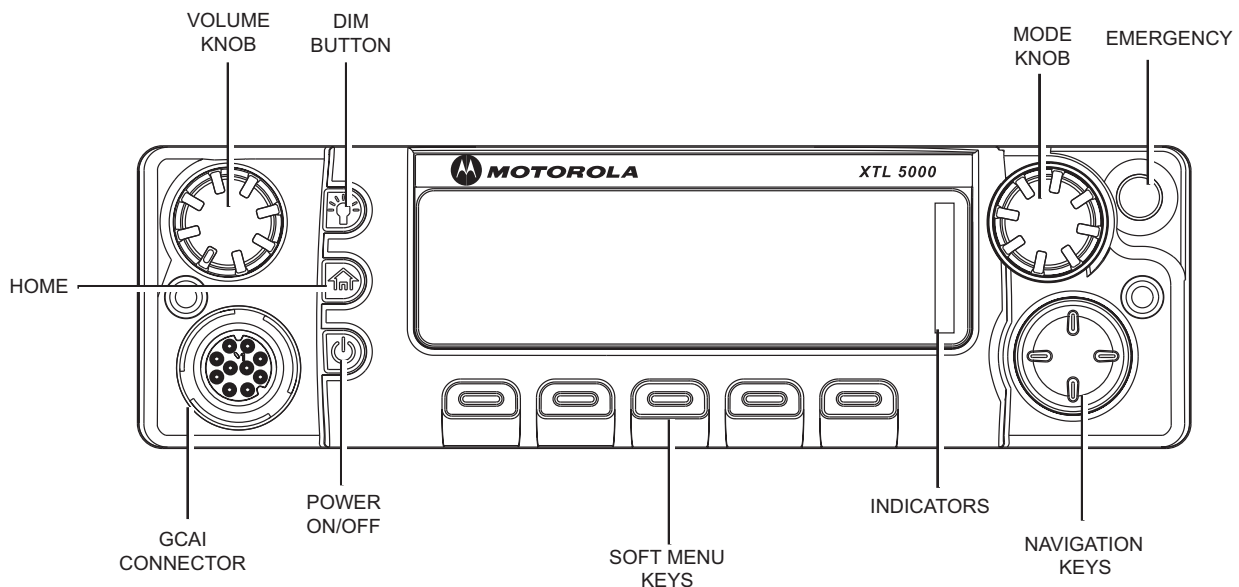


Figure 1-2. XTL 5000 Control Head

#### **1.4.4 XTL 5000 O5 Controls**

- VOLUME KNOB – Changes the audio volume.
- GCAI CONNECTOR – Used to connect accessories, such as the microphone, to the control head.
- DIM BUTTON – Dims the backlight through three levels of brightness including backlight off.
- HOME – Used to exit all menu functions. The long press behavior of the HOME button is programmable.
- POWER ON/OFF – Turns the radio on and off.
- SOFT MENU KEYS – Field-programmable buttons.
- INDICATORS – Red, Yellow and Green LED's that indicate transmit, busy and private call respectively.
- MODE KNOB – Used to change channels.
- NAVIGATION KEY – Used to scroll through menu items and selections.
- EMERGENCY – Field-programmable button via CPS, typically programmed for the emergency feature but other functions are possible.

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## Chapter 2 Basic Maintenance

### 2.1 Introduction

This section of the manual describes preventive maintenance, handling precautions, and some basic repair procedures and techniques. Each of these topics provides information vital to the successful operation and maintenance of your radio.

**NOTE:** For board- and component-level repair of the radio, refer to the *Detailed Service Manual* (see ["Related Publications" on page xvi](#)).

### 2.2 Preventive Maintenance

Radios are shipped from the factory with a worst-case frequency error of:

- $\pm 200$  Hz for VHF
- $\pm 300$  Hz for UHF Range 1
- $\pm 300$  Hz for UHF Range 2
- $\pm 600$  Hz for 700–800 MHz

These specifications are tighter than the more stringent FCC requirements of:

- $\pm 2.5$  ppm for the 136–174 MHz band
- $\pm 2.0$  ppm for the 380–470 MHz band
- $\pm 2.0$  ppm for the 450–520 MHz band
- $\pm 1.5$  ppm for the 700–800 MHz bands

For radios that have been in storage for over six months from the factory ship date, the reference oscillator should be checked when the radio is initially deployed to the field. It is strongly recommended that the reference oscillator be checked every time the radio is serviced or at least once a year, whichever comes first. The crystal contained in the reference oscillator naturally drifts over time due to its aging characteristic. Periodic (annual) adjustment of the reference oscillator is important for proper radio operation. Improper adjustment can result in both poor performance and interference with other users operating on adjacent channels.

#### 2.2.1 Inspection

Check that the external surfaces of the radio are clean, and that all external controls and switches are functional. A detailed inspection of the interior electronic circuitry is not needed.

**NOTE:** Verify that all dust covers are in place.

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## 2.2.2 Cleaning

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external and internal surfaces of the radio. External surfaces include the control head and radio chassis. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime. Internal surfaces should be cleaned only when the radio is disassembled for servicing or repair.



### Caution

The effects of certain chemicals and their vapors can have harmful results on certain plastics. Aerosol sprays, tuner cleaners, circuit board cleaners, alcohols, and other chemicals should not make contact with plastic or metal radio housings. Extreme etching to disintegration of the plastic can result.

Any cleaning to the printed circuit board requires the complete removal of the circuit board from any plastic or metal housings, to prevent the chemical from making contact with the plastic housing. After the printed circuit board has been cleaned and the chemical has evaporated, the circuit board can be returned to the plastic or metal radio housing.

The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dishwashing detergent in water. The only factory recommended liquid for cleaning the printed circuit boards and their components is isopropyl alcohol (70% by volume).

### 2.2.2.1 Cleaning External Plastic Surfaces

The detergent-water solution should be applied sparingly with a stiff, non-metallic, short-bristled brush to work all loose dirt away from the radio. A soft, absorbent, lint-free cloth or tissue should be used to remove the solution and dry the radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.

### 2.2.2.2 Cleaning Internal Circuit Boards and Components

Isopropyl alcohol may be applied with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of the radio. Be careful not to break off electrical components.

Alcohol is a high-wetting liquid and can carry contamination into unwanted places if an excessive quantity is used. Make sure that controls or tunable components are not soaked with the liquid. Do not use high-pressure air to hasten the drying process, since this could cause the liquid to puddle and collect in unwanted places.

Upon completion of the cleaning process, use a soft, absorbent, lint-free cloth to dry the area. Do not brush or apply any isopropyl alcohol to any plastic parts.

**NOTE:** Always use a fresh supply of alcohol and a clean container to prevent contamination by dissolved material (from previous usage).

## 2.2.3 General Radio Care and Handling Precautions

- Avoid physical abuse: do not pound, drop, or throw the radio. Exposed parts, such as controls and connectors, might be damaged.
- Operating the radio without an antenna cable attached may lead to radio failure and may void the warranty.

## 2.2.4 RF Power Amplifier (RF PA) Heatsinking

You should never transmit unless the printed-circuit board (PCB) DC and RF connector clips and internal screws are installed in the chassis. Doing so can result in immediate failure of RF PA devices or greatly reduced RF PA device life. You also can transmit for short periods with the chassis eliminator if it is used properly.

## 2.3 Handling Precautions

Complementary metal-oxide semiconductor (CMOS) devices, and other high-technology devices, are used in this family of radios. While the attributes of these devices are many, their characteristics make them susceptible to damage by electrostatic discharge (ESD) or high-voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair. Handling precautions are mandatory for this radio, and are especially important in low-humidity conditions. DO NOT attempt to disassemble the radio without observing the following handling precautions:

- Eliminate static generators (plastics, Styrofoam, etc.) in the work area.
- Remove nylon or double-knit polyester jackets, roll up long sleeves, and remove or tie back loose-hanging neckties.
- Store and transport all static-sensitive devices in ESD-protective containers.
- Disconnect all power from the unit before ESD-sensitive components are removed or inserted unless otherwise noted.
- Use a static-safeguarded workstation, through the use of an anti-static kit (Motorola part number 01-80386A82). This kit includes a wrist strap, two ground cords, a static-control table mat and a static-control floor mat.

**NOTE:** Be sure that the table and floor mats are properly grounded.

When these items are not readily available, observing the following techniques will minimize the chance of damage:

- If a static-sensitive device is to be temporarily set down, use a conductive surface for placement of the device.
- Make skin contact with a conductive work surface first and maintain this contact when the device is set down or picked up.
- Always wear a conductive wrist strap when servicing this equipment. The Motorola part number for a replacement wrist strap that connects to the table mat is 42-80385A59.

## Notes

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## Chapter 3 Basic Theory of Operation

### 3.1 Introduction

The ASTRO XTL 5000 radio combines the controller and RF sections into a single board and contains the following modules:

- Daughtercard
- RX VCO module (700—800 MHz only)
- TX VCO module (700—800 MHz only)

It is important to correctly identify the malfunctioning region before replacing expensive modules. To assist with radio repair, descriptions of the sections contained on the XTL 5000 uniboard are listed below.

### 3.2 General Overview

The XTL 5000 radios are wideband, synthesized, fixed-tuned radios and are available with the following frequency bands:

- VHF (136—174 MHz)
- UHF Range 1 (380—470 MHz)
- UHF Range 2 (450—520 MHz, Mid Power Models Only)
- 700—800 MHz (Mid Power Models Only)

All XTL 5000 radios are capable of both analog operation (12.5 kHz, 20 kHz, and 25 kHz bandwidths) and ASTRO mode operation (12.5 kHz bandwidth).

The XTL 5000 O3 radios contain the following assemblies and sections:

- O3 Control Head Assembly — The control head assembly contains the LCD display, User Interface, OMAP microprocessor, and a Synchronous Serial Interface (SSI) to communicate with the RF transceiver. The CHIB that was previously used with the O5 Control Head during remote mount operation has been incorporated into the O3 Control Head. This allows the Control Head to be attached to the RF Transceiver via Transceiver Interface Board (TIB) using the CAN protocol regardless of mounting configurations. The only difference between Dash mount and Remote Mount is the additional 17' Straight cable.
  - O5 Control Head Assembly — The control head assembly contains the LCD display, User Interface, OMAP microprocessor, and a Synchronous Serial Interface (SSI) to communicate with the RF transceiver. For the dash mount configuration, the control head assembly is attached directly to the RF transceiver via a flex. For the remote mount configuration, the control head assembly is attached to the Control Head Interface Board (CHIB) via a flex and then connected to the RF Transceiver via the TIB.
  - The CHIB contains a SSI-CAN FPGA, a 16 bit CODEC for audio processing, a Class D Audio PA, and three Controller Area Network (CAN) transceivers. Each CAN transceiver is used to communicate with the RF transceiver, one for audio, one for data, and one for system power-on commands.
  - Transceiver Interface Board — Contains CAN transceivers and audio and digital routing for accessories. The TIB is used with the O3 Control Head for Dash and Remote Mount configuration but is only used for Remote Mount configuration with the O5 Control Head.
-

- Power Amplifier (PA) section—contains the antenna switch, directional coupler/ detector, and amplifier(s).
- Front-End Receiver section—contains the preselector, low-noise amplifier (LNA), and mixer.
- IF section—contains the receiver intermediate-frequency (IF) amplifier/filter and the digital receiver back-end integrated circuit (IC).
- Frequency Generation section—contains the synthesizer, voltage-controlled oscillators (VCOs), reference oscillator, and receive and transmit buffers.
- Controller section— contains the following elements:
  - Voltage regulators and data communication circuitry (RS232, USB, and SB9600)
  - Daughtercard module (Microprocessor, FLASH IC, SRAM IC)
  - Modulation D/A conversion circuitry
  - CODEC audio circuitry
  - TX power-control circuitry
  - Emergency circuitry
  - V.I.P input/output paths
  - Secure interconnect board interface
  - Front connector interface for control heads and Transceiver Interface Boards (TIB).
  - Rear connector for additional accessories (Mid Power Only)
  - Global Core Accessory Interface (GCAI) connector
  - DC power-in plug

## 3.3 Controller Section

### 3.3.1 Introduction

The XTL 5000 transceiver is a uniboard design, consisting of isolated topside and bottomside controller sections and multiple RF sections. The controller section is divided into two parts: the "daughtercard module" and the "controller region".

**NOTE:** A control head is not necessary for the function of the radio (in special application configurations), but the controller section is critical for the RF sections to function. This is an important point since repairs and troubleshooting of the RF sections usually require that the controller section be operating correctly.

### 3.3.2 Location

The controller section is located on the far side of the board with critical parts arranged on the top and bottom sides of the uniboard (see [Figure 3-1](#) below, with component-filled areas denoting the controller section).

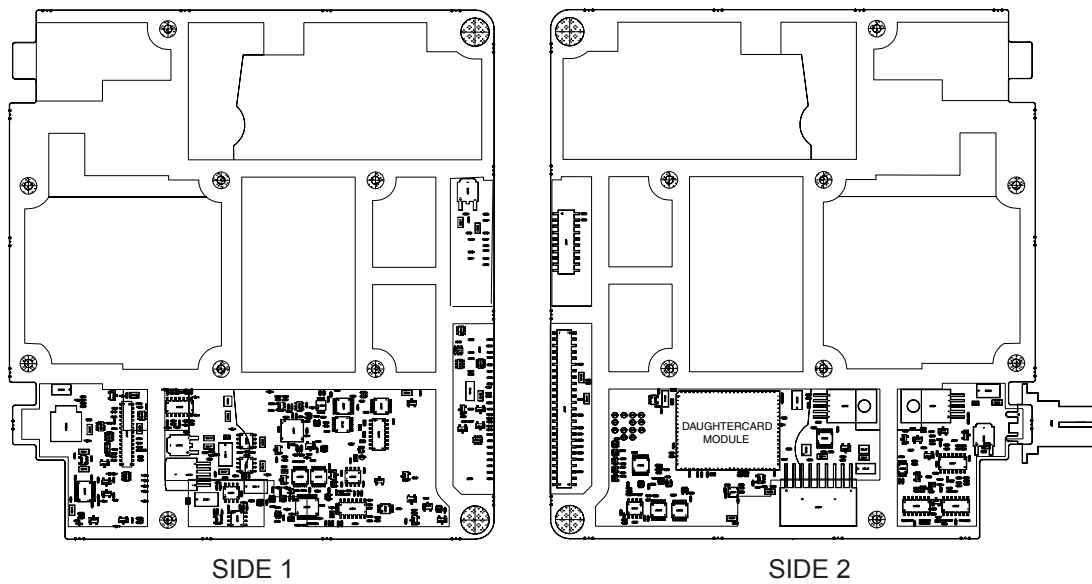


Figure 3-1. Controller Sections (Mid Power)

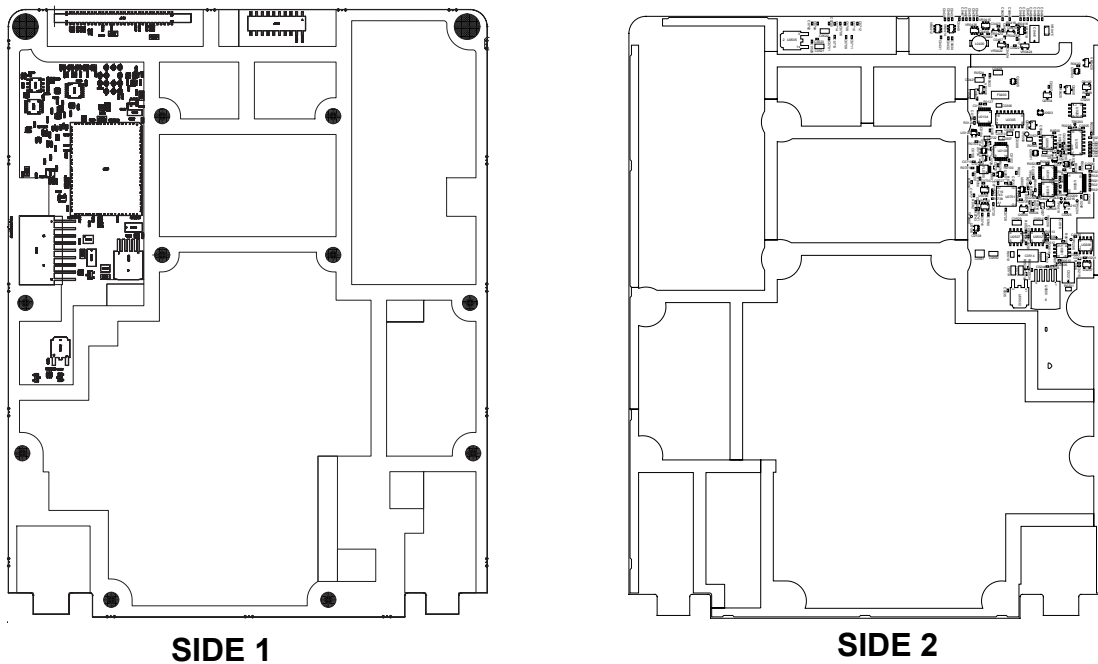


Figure 3-2. Controller Sections (High Power)



Troubleshooting the controller section usually requires removal of the uni-board from the chassis. Whenever this board is removed, any transmitting by the RF section, whether intentional or accidental (e.g. trunking affiliation), can cause permanent destruction or degradation of various RF components. Such damage may not be visually noticeable, but can impact the radio's performance and reliability.

### 3.3.3 Daughtercard Module

This module contains primarily three parts: microprocessor, FLASH IC, and SRAM IC.

**NOTE:** The three parts on the daughtercard module are highly susceptible to ESD and moisture damage. Extreme care is advised.

#### 3.3.3.1 Microprocessor

The microprocessor consists of an MCORE-based controller and a DSP that communicates with the memory ICs via a 16-bit data bus. It also communicates to peripheral ICs on the main board via an SSI and SPI bus. This microprocessor contains a fixed amount of one-time programmable ROM and a small section of RAM. However, the microprocessor does not contain the radio software setting as programmed in the Customer Programming Software (CPS) or the firmware as installed at the factory. The only purpose of this IC is for interpretation and processing of the content inside the FLASH IC. Therefore, this part may be replaced, as is, without the need to reflash the radio.

There are six clocks supplied to the daughtercard, a 16.8 MHz master clock (CKIH), a 32 kHz real-time clock (CKIL), a 20 kHz RX frame-sync clock, a 48 kHz TX frame-sync clock, a 1.2 MHz RX data clock, and a 2.4 MHz TX data clock. The microprocessor also generates the digital audio bus clocks: a 512 kHz data clock and an 8 kHz frame-sync clock.

#### 3.3.3.2 FLASH IC

The FLASH IC is the firmware storage IC. Programming this IC is accomplished using one of the programming cables and input paths listed in [Table 4-7, "XTL 5000 Radio Field-Programming Items," on page 4-4](#):



Caution

If you choose to reflash the radio (reflash the IC), DO NOT interrupt the process; otherwise, you might corrupt the FLASH IC and need advanced technical support to revive your radio.

**NOTE:** It is recommended that FLASH IC replacement is not supported as a field-repair option. If this part is removed, the radio must be reflashed and retuned. This is because the FLASH IC must be hard-boot loaded at the factory to allow the programming of a unique file.

#### 3.3.3.3 SRAM IC

The SRAM IC is used only by the microprocessor to perform its memory operations and is not upgradeable to a larger SRAM IC.

### 3.3.4 Controller Region

#### 3.3.4.1 Introduction

The controller region contains the regulated power, audio and data translation hardware.

This hardware allows a computer to program the radio's features, maintain an active control of the RF sections, and make necessary mode and audio adjustments as related to feedback from a control head device.

### 3.3.4.2 Voltage Regulation

The uniboard contains the following voltage regulators: 9 V, 5 V, 3 V, 2.85 V, 1.85 V, and 1.55 V.

The radio's A+ supply is regulated down to additional supplies for various blocks (frequency generation unit (FGU), receiver, transmitter power amplifier, and controller). Specifically, A+ is used to regulate three separate 9.3-volt supplies: one for the FGU and receiver circuitry, one for the transmitter power amplifier circuitry, and one for the controller sections.

- The FGU and receiver circuitry use the 9.3-volt supply to further regulate a common 5-volt supply and two separate 3-volt supplies: one for the FGU and one for the back-end receiver.
- The transmitter power amplifier uses a second 9.3-volt supply directly for the pre-amplifier stage and as the input to a 3-volt supply for most of the ALC (automatic level control) circuitry.
- The controller uses the third 9.3-volt supply to power the microphone, part of an RS232 translator, and to provide voltage to the 5-volt regulator, which supplies the 2.85 V, 1.85 V, and 1.55 V supplies.
  - The 2.85-volt regulator supplies most of the digital logic circuitry on the controller, as well as the I/O of the microprocessor.
  - The 1.85-volt regulator supplies the FLASH and SRAM circuitry.
  - The 1.55-volt regulator supplies the core of the microprocessor.

### 3.3.4.3 Emergency

Circuitry exists to support emergency footswitch operation. If the proper features are enabled in the codeplug using the customer programming software (CPS), then depressing the emergency footswitch will turn the radio on and alert dispatch. A button on the control head can also be programmed using CPS to activate emergency when the radio is on. The emergency button on the control head will not turn the radio on.

**NOTE:** If this feature is not used on mid-power transceivers in the dash mount configuration, then the emergency pin of the rear connector (J2-15) must be shorted to ground.

This feature is either visual or can be set to covert, and is programmable through the CPS. This functionality is dependent on the CPS version and customer demand for feature availability.

### 3.3.4.4 Audio (Dash Mount)

The audio circuitry of the controller section contains the following:

- Audio PA
- Codec
- MIC Audio
- Microprocessor controlled EPOTS
- AUX RX, AUX TX, and external speaker paths
- FILT audio.

In addition to providing basic transmit and receive audio, this circuitry provides the audio paths to interface with existing accessories made by Motorola, such as the Vehicular Repeater System (VRS), SIREN, and Consolette. It also allows for select compatibility with aftermarket modems. Block diagrams for the transmit and receive paths are shown in [Figure 3-3](#) and [Figure 3-4](#).



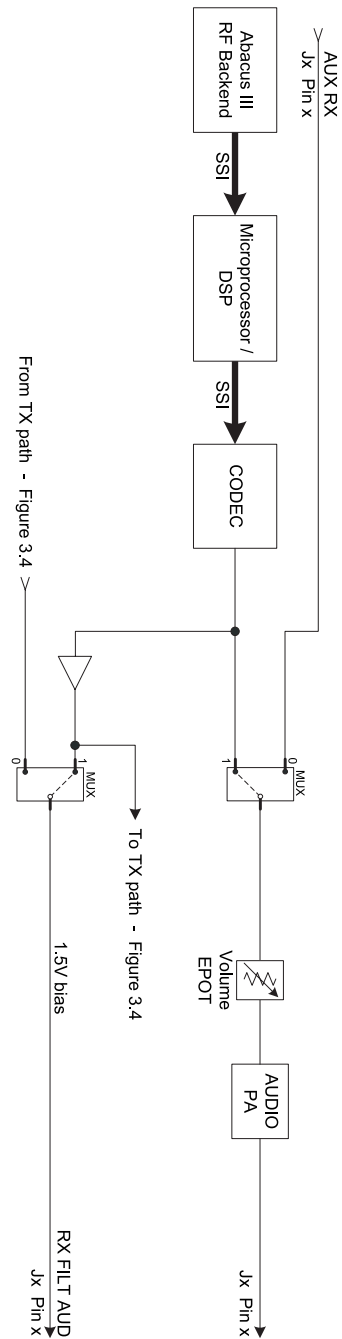


Figure 3-3. Audio Receive Path in XTL 5000 Transceiver

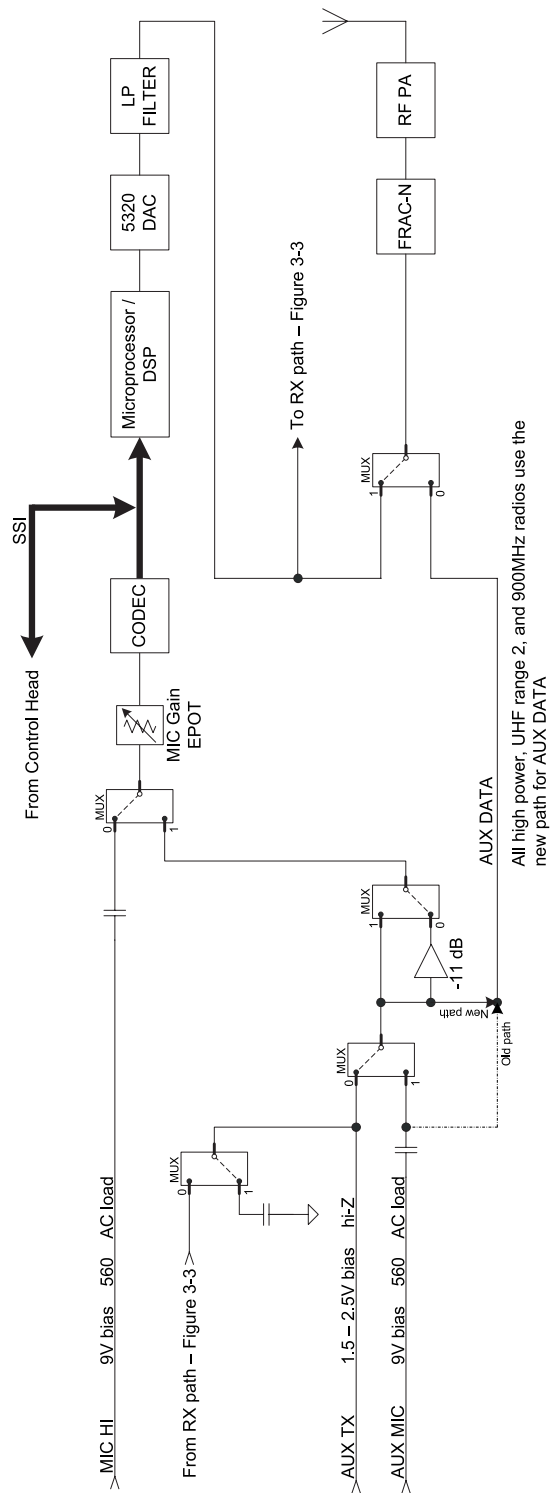


Figure 3-4. Audio Transmit Path in XTL 5000 Transceiver

### 3.3.4.5 Front and Rear Connectors

The controller section contains the front connector (J0401) used to interface with the control head and, on mid power models, a rear connector (J2) that is used to interface with accessories. The pin-out for rear connector J2 is shown in [Section 9.2.2 on page 9-3](#) while the pin-out for front connector J0401 is shown in [Figure 10-15](#) for mid power models and [Figure 10-17](#) for high power models. These connectors allow connection to several serial interfaces, transceiver inputs and outputs, audio inputs and outputs, and accessory power.



Caution

These custom connectors are optimized to meet voltage and current requirements for existing accessories and for the compatible flexes that are used with the XTL 5000 radio. Inserting non-Motorola parts or flexes into these connectors is not recommended. Failure to do so can result in equipment damage.

### 3.3.4.6 Serial Interfaces

Several serial interfaces are supported by the XTL 5000 transceiver. The mid-power transceiver has four serial interfaces at the rear 26-pin connector J2 and five serial interfaces at the front 50-pin connector J0401. The J2 interfaces are 4-wire UARTA, SB9600, USB, and ONE-WIRE. The J0401 interfaces are 4-wire UARTA, 2-wire UARTA, SB9600, ONE-WIRE, and SSI. For high power, there is no J2 connector. However, the high power radio's front 60-pin connector J0401 has six serial interfaces: 4-wire UARTA, 2-wire UARTA, SB9600, ONE-WIRE, SSI, and USB. SB9600 is a Motorola proprietary serial bus used to communicate with accessories. The ONE-WIRE interface is used for accessory detection. UARTA multiplexes both RS232 and USB. Therefore, you can use either USB data or RS232 data at one time, not both simultaneously.

### 3.3.4.7 USB and RS232 Interfaces

There are multiple locations on the radio to perform either USB or RS232 data communications for programming or other applications. On a midpower transceiver, the rear connector J2 has dedicated USB and RS232 lines. Also, in remote mount, both the highpower and midpower have 4-wire RS232 at the J600 connector and 2-wire RS232 at the J700 connector. On highpower, in order to use the TIB's GCAI J700 for USB programming, the USB data lines are routed to the front of the transceiver giving the highpower USB capability at J700. However, the midpower transceiver does not route the USB lines to the front connector, so the TIB's GCAI connector J700 has no USB connection, and therefore midpower does not support USB at J700.

The USB and RS232 lines are multiplexed into a single UART\_A inside the transceiver, so the microprocessor is only capable of either RS232 or USB at one time. When the GCAI USB cable is attached to the TIB at J700 (when attached to a highpower transceiver) the USB transceiver is connected to the microprocessor, and RS232 at any connector is not operational. When a GCAI RS232 cable is attached to the TIB at J700, the RS232 transceiver is connected to the microprocessor, and the GCAI connector becomes the only path for RS232. The other connectors are not operational for RS232 since the GCAI J700 2-wire RS232 cable is now the only path to the RS232 transceiver. The ability of the transceiver to determine which kind of cable is attached is due to the fact that a dedicated ID device called ONE-WIRE is located in each cable, which is read upon attachment of a programming cable. The cable ID informs the microprocessor as to which type of data communications need to be performed, and the MUXing for either RS232 or USB is performed inside the transceiver.

### 3.3.4.8 Transceiver Inputs

Four transceiver input signals are present at the rear connector J2 and three of these signals are present on front connector J0401. The four J2 inputs are active low PTT, IGNITION, EMERGENCY, and MONITOR. The MONITOR input is not present on the front connector. IGNITION and EMERGENCY have the ability to turn the radio on. For EMERGENCY, circuitry in the transceiver turns the system on. For IGNITION, either the control head or the Transceiver Interface Board (TIB) turns the system on depending on whether the system is in the dash or remote configuration. In addition to PTT, IGNITION, and EMERGENCY, the front connector also contains the VIP IN 1 and VIP IN 2 signals. These signals will be discussed in section 3.6 under Vehicle Interface Port (VIP).

### 3.3.4.9 Transceiver Outputs

Three transceiver output signals are available at rear connector J2 and two of these signals are present on front connector J0401. The three J2 outputs are CHANNEL ACTIVITY, VIP OUT 1, and VIP OUT 2. CHANNEL ACTIVITY is not present on the front connector.

### 3.3.4.10 Audio Inputs and Outputs

One audio input and two audio outputs are available at both rear connector J2 and front connector J0401. The audio input is AUX\_MIC. One line level audio output is RX\_FILT\_AUDIO and the final audio output is the speaker amplifier differential output comprised of SPKR+ and SPKR-.

### 3.3.4.11 Accessory Power

SW\_B+ is sourced from the control head in the dash mount configuration and the TIB in the remote mount configuration. SW\_B+ enters the transceiver through the front connector J0401. Applying SW\_B+ to the front connector turns the transceiver on. SW\_B+ is also routed to rear connector J2 to provide power for accessories. Two ground pins are available on rear connector J2 and four ground pins are available on the front connector. The maximum current available to accessories via the rear connector SW\_B+ pin is 8 amps.

## 3.4 O3/O5 Control Head Assembly

The XTL 5000 O3 control head assembly consists of the main board, Keypad Flex, Side Button Flex and LCD display module. Circuits on the main board include the OMAP microprocessor, FLASH memory, SDRAM memory, FPGA, CAN transceivers, AVR Power On/Off circuit and the control head voltage regulators. The control head is connected to the transceiver unit using a CAN cable and this applies to Dash mount and Remote mount. The control head communicates to the TIB on the transceiver unit using the Controller Area Network (CAN) protocol.

The XTL 5000 O5 control head assembly consists of the main board, LCD display module, and mechanics that include the volume knob, mode knob and user interface buttons. Circuits on the main board include the OMAP microprocessor, FLASH memory, SDRAM memory, and the control head voltage regulators. In dash mount the control head assembly is mounted directly to the transceiver unit. In remote mount, the control head assembly is mounted to the Control Head Interface Board (CHIB).

### **3.4.1 OMAP Microcontroller**

The Texas Instruments OMAP microcontroller is used to perform control head operations. The user interface for O5, consisting of nine buttons, the volume knob, and 16 position mode knob and for O3 consisting of 32 buttons is read by OMAP and the input is passed to the transceiver unit via the Synchronous Serial Interface (SSI). In the dash mount configuration for the O5, the OMAP SSI bus is connected directly to the transceiver microprocessor's SSI bus. In remote mount for O5, the OMAP SSI bus is converted to the Controller Area Network (CAN) protocol by the CHIB. For the O3 Dash mount and remote mount configuration, the SSI is passed to the FPGA unit where it is converted to the CAN protocol and sent to the CAN Transceivers which transmits the CAN signal over the CAN cable. The CAN signal is received by the Transceiver Interface Board (TIB), which converts the signal back to SSI and routes the signal to the transceiver microprocessor. OMAP uses two clocks, a 32kHz clock supplied by an external oscillator and a 12MHz clock supplied by an internal oscillator.

### **3.4.2 Field-Programmable Gate Array (FPGA)**

The FPGA implements an SSI to CAN-protocol translation, which is used to provide a remote link between the Control Head and radio transceiver, through the TIB, in a remote mount configuration. Each processor uses SPI to configure the FPGA at each startup (the OMAP programs the CHIB's FPGA, and the radio transceiver microprocessor programs the TIB's FPGA). Once the FPGA is programmed, each processor uses the SSI bus to send/receive data to/from the FPGA, clocked at 1.536Mhz and synchronized at 8kHz. The FPGA converts this SSI data into a CAN-protocol, which is input into 2 CAN transceivers (digital data stream and digital audio stream), and out special CAN cables to/from the O3 controlhead, the TIB, or the CHIB based on control head configuration. The third CAN Transceiver (power on/off/reset) is not controlled by the FPGA. For the O3, there is a 10 foot coiled CAN cable, and a 17 foot straight extension cable. For the O5, there are a variety of fixed-length CAN cables (3 meters to 40 meters).

### **3.4.3 Controller Area Network (CAN) Transceivers**

There are a total of 3 CAN Transceivers located on the O3 Control Head, 3 on the TIB, and 3 on the CHIB. CAN1 is used for digital Audio, CAN2 is used for digital Data and CAN3 is for digital Power ON/OFF/RESET pulses. If an O5 control head is used, a TIB and CHIB must be present. If an O3 control head is used, only a TIB must be present, since the O3 control head has the CAN transceivers located on its PCB's. The CAN bus provides a 1MB/s data link. Only the list of approved Motorola CAN cables are to be used for any remote mount installations.

### **3.4.4 Power Management**

The remote mount radio system uses a CAN protocol for turning-on, turning-off, and resetting the entire system. That means for normal operation, you will never have only part of the radio system operating. Either it is "all on" or "all off". Regarding specific regulator aspects of the radio, the Control Head assembly contains a 5-volt switching regulator that is supplied by A+. When enabled, the 5-volt regulator output is applied to a TI power management IC. For the O5 Control Head, A+ is also applied to a 2.8V regulator and a MOSFET that is used as a switch to provide "switched B+" to the radio transceiver in dash mount configuration. The ATMEL AVR, advanced RISC microcontroller is used on the O3, O5, and TIB to power-on, power-off, and reset the entire radio system. It has multiple inputs for determining the correct state of the radio as well as inputs to detect a request to change the state of the radio, either externally, or via processor GPIO's (refer to the detailed service manual for specifics). The TI power management IC provides three voltages that are used by the control head which are 3.3-volts, 1.8 volts, and 1.5-volts. The 3.3-volt supply is primarily used by the USB transceiver internally to OMAP and FPGA. The 3.3-volt supply and 2.8-volt supply are used the FPGA's general purpose inputs and outputs (GPIO's) in addition to most of the analog circuits on the main board. The 1.8-volt supply is used by the FLASH and SDRAM memory modules. The 1.5 volt

supply is used by the OMAP core and FPGA core. The AVR also provides a watchdog function to the control head. The watchdog function is implemented for two conditions. First, if the AVR does not receive a response from OMAP within eight seconds after power-up, then the AVR will disable the 5-volt regulator. Second, when the user presses the power button, a 250ms counter is started. If OMAP does not reset the countdown or cancel the countdown before the 250ms has expired, then the AVR will disable the 5 volt regulator. Within the O3 Control Head main board, A+ is used by the LCD display module where the A+ is regulated by a 12V regulator and this is then supplied to the LCD backlight driver as the voltage input. If ignition is to be used as a means to sense power-on or power-off, then the CPS software tool can be used to enable ignition sensing and control a variety of customer power configurations.

### 3.4.5 SPI Controller

The SPI Controller has the responsibility for interfacing to the system SPI bus to provide a control and status register interface for the FPGA. The SPI is provided by the OMAP Microcontroller and this is done during system power up. Only then the FPGA behaves as a SSI-CAN-SSI Controller.

### 3.4.6 Flash IC

The FLASH memory is used to store the control head firmware. In addition, the codeplug setting for ignition is stored in the control head FLASH. The FLASH is updated after communications is established with the transceiver. Therefore, after the ignition setting has been changed in the codeplug using CPS, the radio should be turned on with the control head so that the control head FLASH will be updated. Otherwise, the FLASH will update in the field on the first successful power-up sequence.

### 3.4.7 SDRAM IC

SDRAM is volatile memory used by the processor to perform normal operations. SDRAM is not field upgradeable.

### 3.4.8 Color Liquid Crystal Display (LCD) module for O3

The LCD module contains a 130x130 dot matrix LCD display and backlight LED's. The LCD module uses two voltages, A+ and 2.8-volts. The display module is driven by an LCD controller internal to OMAP. The display interface consists of eight data lines, D0-D7, and three clock/synchronization lines. The control head firmware divides the display into four sections. Along the bottom, the software menu button labels are displayed. The next row up is the primary text area. The third row up is the secondary text area. And finally, along the top of the display is the icon area. The maximum primary text area character is 12x18 pixels and 10x15 pixels for secondary and tertiary text area.

### 3.4.9 Tri-Color Backlit BW Liquid Crystal Display (LCD) module for O5

The LCD module contains a 320x83 dot matrix LCD display, backlight LED's, and indicator LED's. The indicator LED's have shutters that cover the LED when not in use. This prevents external light from reflecting off the LED, giving the user the false impression that the LED is active. The LCD module uses two voltages, SW\_B+ and 2.8-volts. The display module is driven by an LCD controller internal to OMAP. The display interface consists of eight data lines, D0-D7, and three clock/synchronization lines.

The control head firmware divides the display into four sections. Along the bottom, the software menu button labels are displayed. The next row up is the primary text area. The third row up is the secondary text area. And finally, along the top of the display is the icon area. Both the primary and secondary text area's can display 14 characters.

### 3.4.10 O3 Dash Mount

The O3 control head will support dash mounting with the XTL 5000 mid-power transceiver only.

In dash mount configuration, the 10 foot coiled CAN cable on the O3 control head will attach directly to the XTL 5000 TIB.

- Siren and DEK will NOT be supported.
- VIP In will NOT be supported.
- Audio Recording will NOT be supported.
- VRS and DVRS will NOT be supported.

Speaker, Emergency Footswitch and Ignition will be routed via the J2 connector at the rear of the mid-power transceiver, using the existing Quest cables.

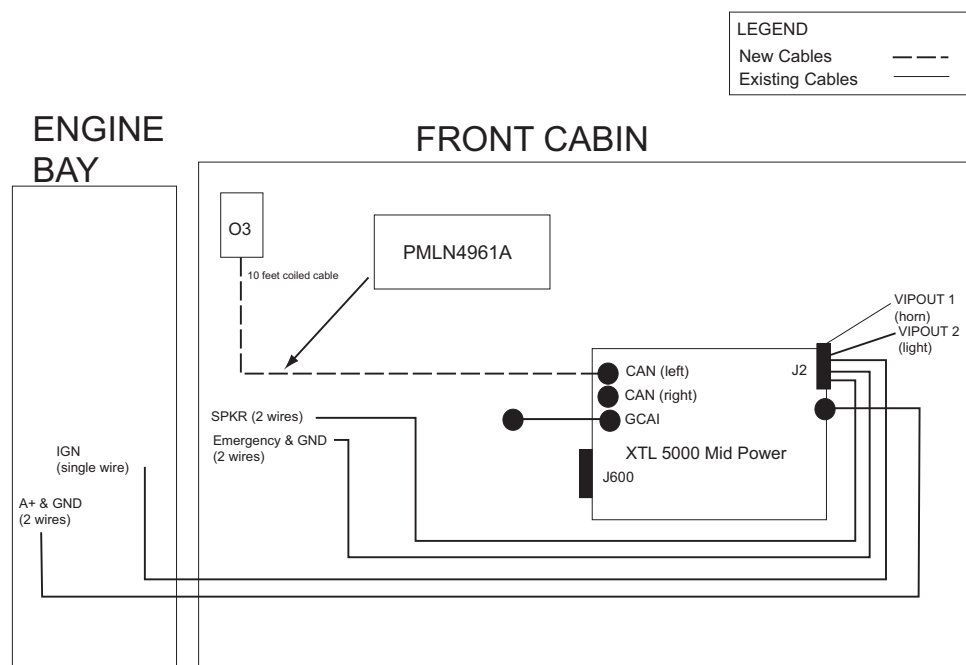


Figure 3-5. O3 Dash Mount Configuration

### 3.4.11 O3 Remote Mount

The O3 control head will support remote mounting with both the Millennium mid-power and high-power transceivers.

In remote mount configuration, the 10 foot coiled CAN cable on the O3 CH will connect to a 17 foot CAN straight cable, which attaches to the TIB.

- Siren will be supported.
- DEK will be supported (only if Siren is installed).
- VIP In and Out's will be supported through the DEK (only if both Siren and DEK are installed).
- DVRS will be supported.

Digital vehicular repeater system (DVRS) connection is done via the J600 connector on the TIB using RS232 communication.

Programming capability will only be available on the trunk mounted transceiver via the GCAI connector (J700).

Speaker, Emergency Footswitch, Ignition and Audio Recording will be routed via the J600 connector at the front of both the mid-power and high power transceivers.

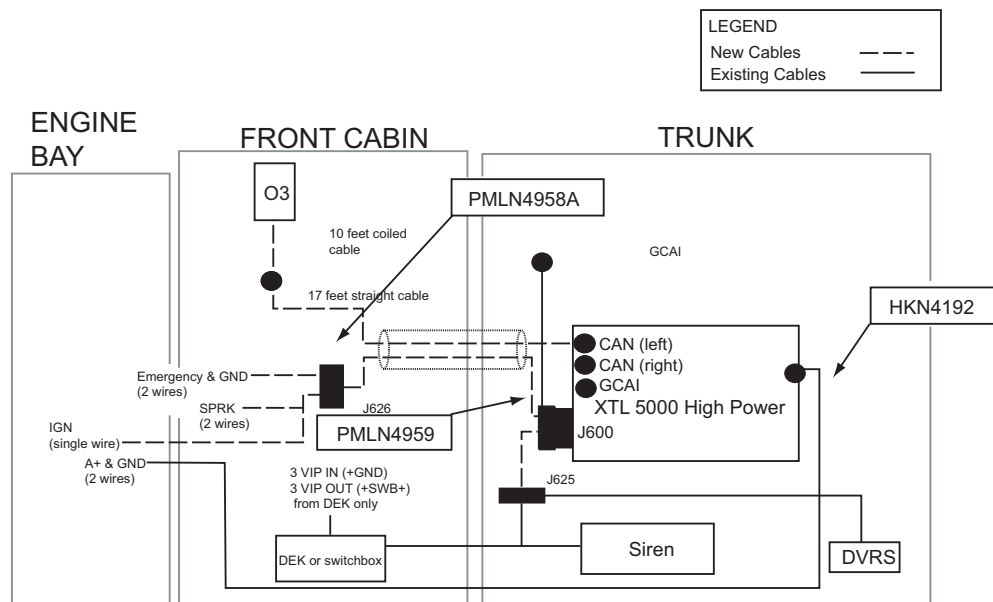


Figure 3-6. O3 Remote Mount Configuration



### 3.4.12 Vehicle Interface Port (VIP)

#### 3.4.12.1 O3/O5 Remote-Mount

The VIPs allow the control head to operate external circuits and to receive inputs from external circuits. There are three VIP outputs and three VIP inputs that are located on the back of the control head in connector J400 (only for O5) and on the transceiver interface board (TIB) in connector J600. The three VIP outputs in the J400 connector are implemented as open-drain MOSFETS capable of sinking 500 mA. Most applications use a relay connected between SW\_B+ and the VIP output. Typical applications for VIP outputs are: external horn/lights, alarm, and horn-ring transfer. Shorting SW\_B+ directly to any of the VIP output lines without the use of a current limiting load will damage the MOSFETS. If the load is a relay, then a back-EMF protection diode is recommended. Refer to the installation manual for a graphical description.

The three VIP inputs in the J400 connector are internally pulled high. An external accessory would pull the VIP input to ground to trigger a VIP input. Each VIP input transistor is connected to a dedicated input port and buffered for input protection. VIP functionality is field programmable using CPS. See installation manual HLN6923 for more information on VIP features, wiring, and operation. On the TIB there are two VIP outputs present at J600. One is a dedicated VIP output but the second must be configured as a VIP output by changing a jumper. There are also two VIP inputs present at J600, but these are also only available by changing a jumper on the TIB.

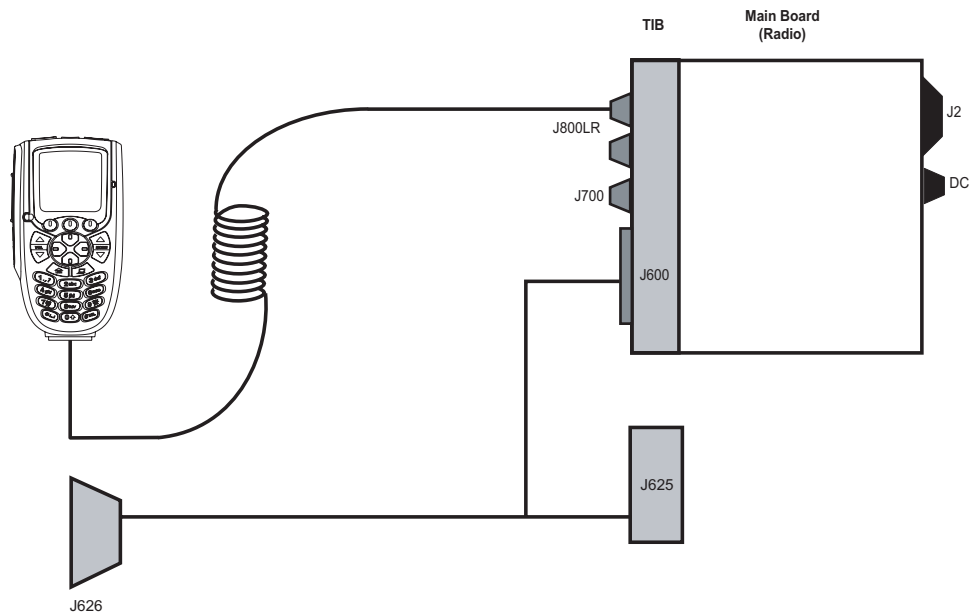


Figure 3-7. Single O3 Control Head + VIPS

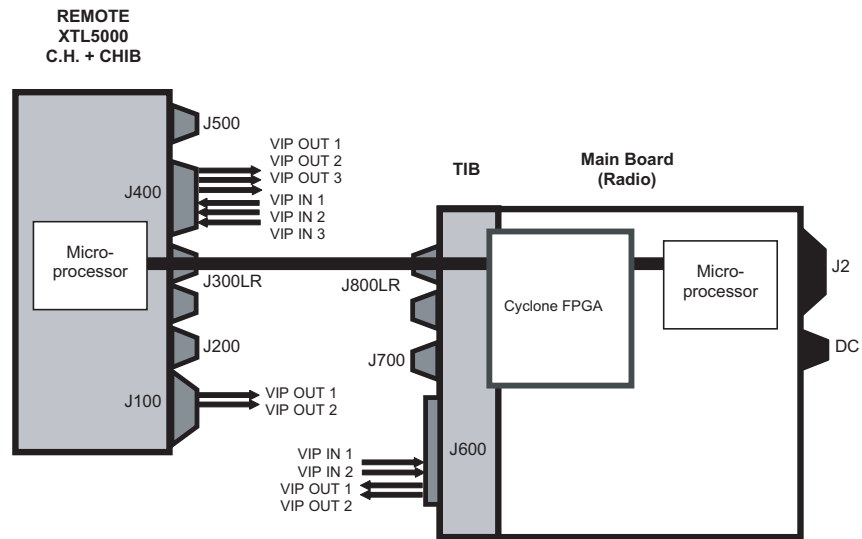


Figure 3-8. Single O5 Control Head + VIPS

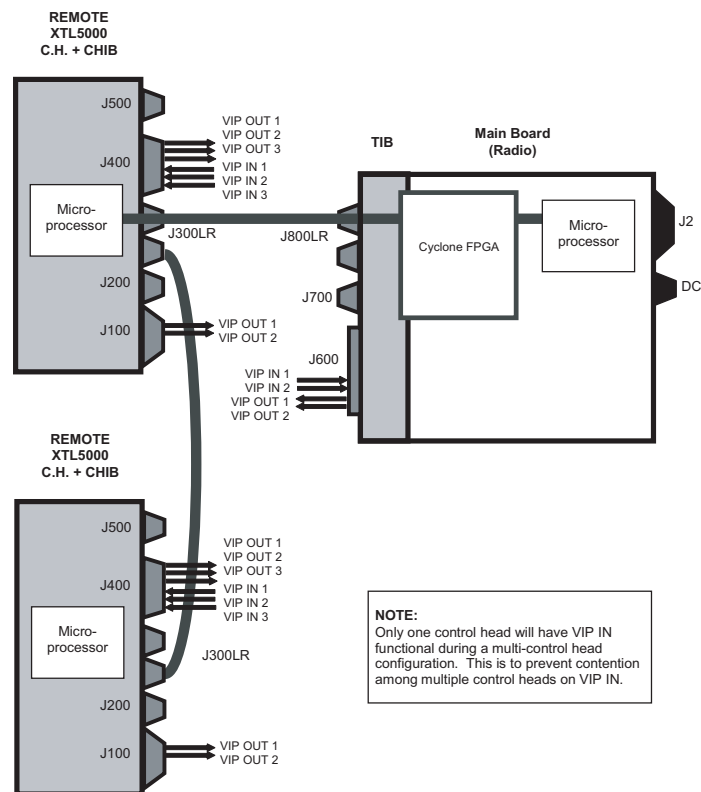


Figure 3-9. Multiple O5 Control Heads + VIPS

### 3.4.12.2 O5 Dash-Mount (Mid Power Only)

In the dash-mount configuration, two VIP outputs are available. These outputs are driven by open drain MOSFETS on the control head. These VIP outputs pass through the transceiver to rear connector J2. Primarily, these transistors control external relays. The relay is connected between the VIP output and switched B+. Refer to the Remote-Mount section for duplicate information on VIP drive strength and warnings.

No VIP inputs are available in the dash-mount configuration.

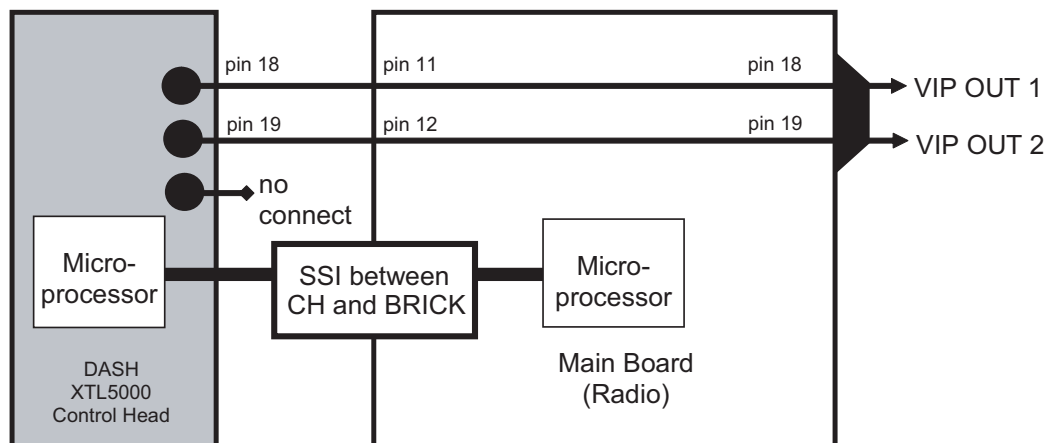


Figure 3-10. Single Control Head + VIPs

### 3.4.13 Data Entry Keyboard (DEK)

In the remote-mount configuration, the DEK box allows the programming of a single button to perform a function that was selected in the CPS, when the radio was configured. The DEK box is typically used for SIREN, to allow different modes or audio siren's from being selected by the push of a button.

Another use of the DEK box is the availability of 3 dedicated VIP-IN's and 3 dedicated VIP-OUT's. For a single DEK and controlhead configuration, Relays can be attached to the VIP pins in order to either allow your radio to toggle the relay via VIP-OUT, or to allow the radio to detect a change in mode, such as with the VIP-INs. Once you begin to add multiple controlheads and DEK boxes, please note that VIP-IN's are only allowed on the back of DEK on 1 CH. This control head must be the only "VIP In Selected" control head in the configuration. Control Heads ship "VIP In Selected." When dual control heads are connected, one must be **front-panel programmed in software** to de-select VIP-IN operation. If the software detects dual control heads with VIP IN selected, an error will be reported.

**NOTE:** the software cannot detect when VIP-INs are physically connected to a control head which has had its VIP-INs de-selected/disabled by front-panel programming. No warning will appear if VIP-INs are physically attached at both control heads.

**NOTE:** Dual control head will be available in the future.

There is no limitation as to where to tap-off for VIP-INs whether it is the backside of the DEKs found on the first CHIB, or the backside of the DEKs found at the second CHIB, etc. However, all 3 VIP-INs must only tap-off at whichever location is chosen. In other words, all must be at only one location at a single controlhead. VIP-OUTs may be present on any or all of the control heads in the system. The VIPs interface to the DEK, which interfaces with the Control Head.

The Control Head is programmed within CPS to know the function of VIP 1,2,3 at DEK A; VIP 1,2,3 at DEK B; and VIP 1,2,3 at DEK C. Please refer to the CPS help menu for complete descriptions of the features that are selectable for the DEK

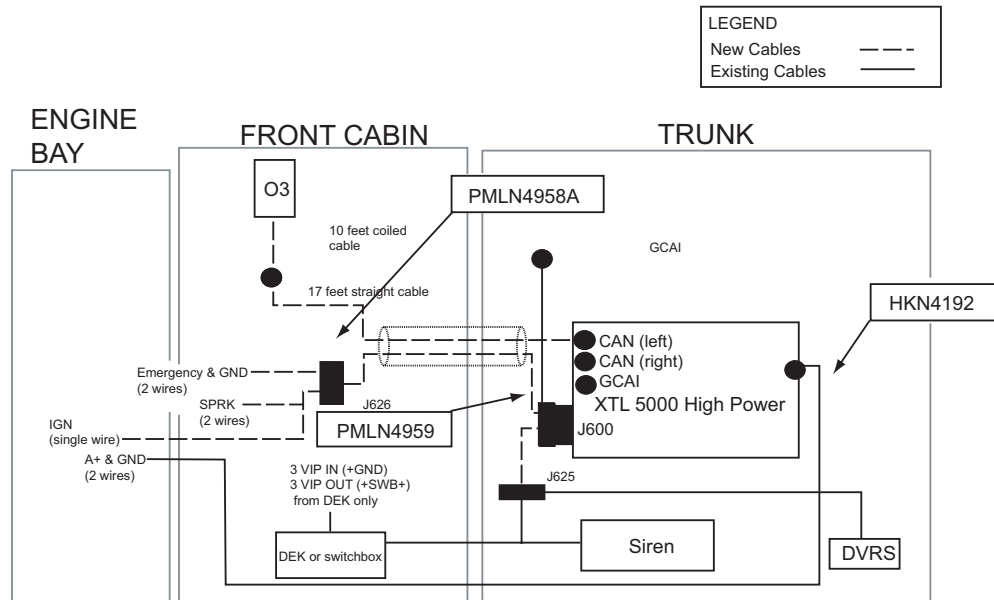


Figure 3-11. Single O3 Control Head + DEK + VIPS

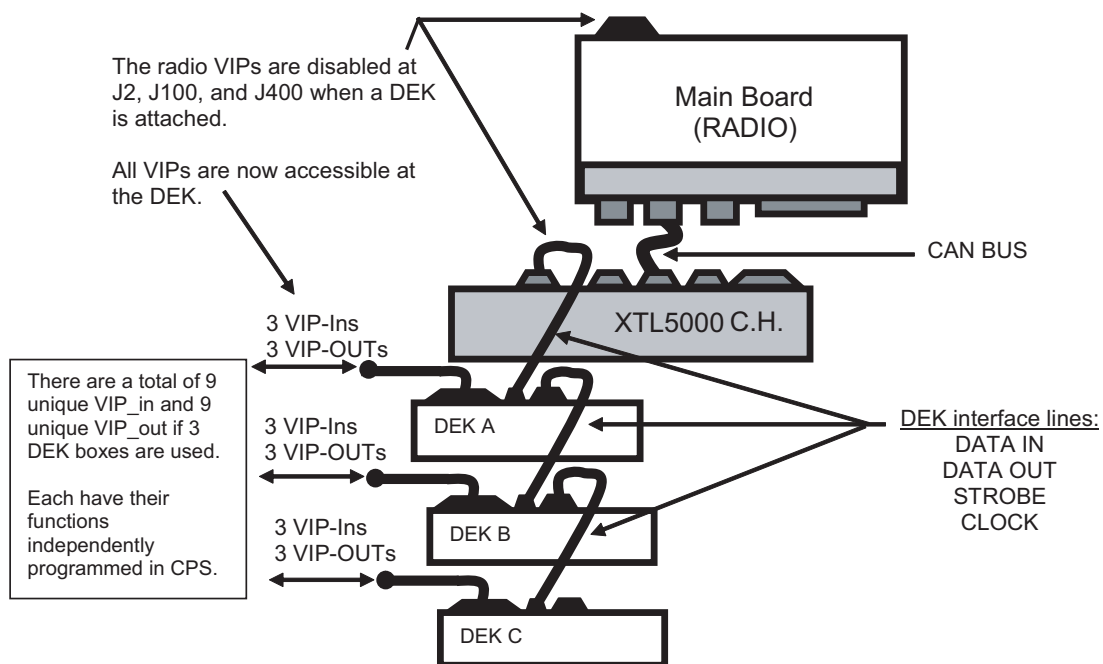


Figure 3-12. Single O5 Control Head + DEK + VIPS

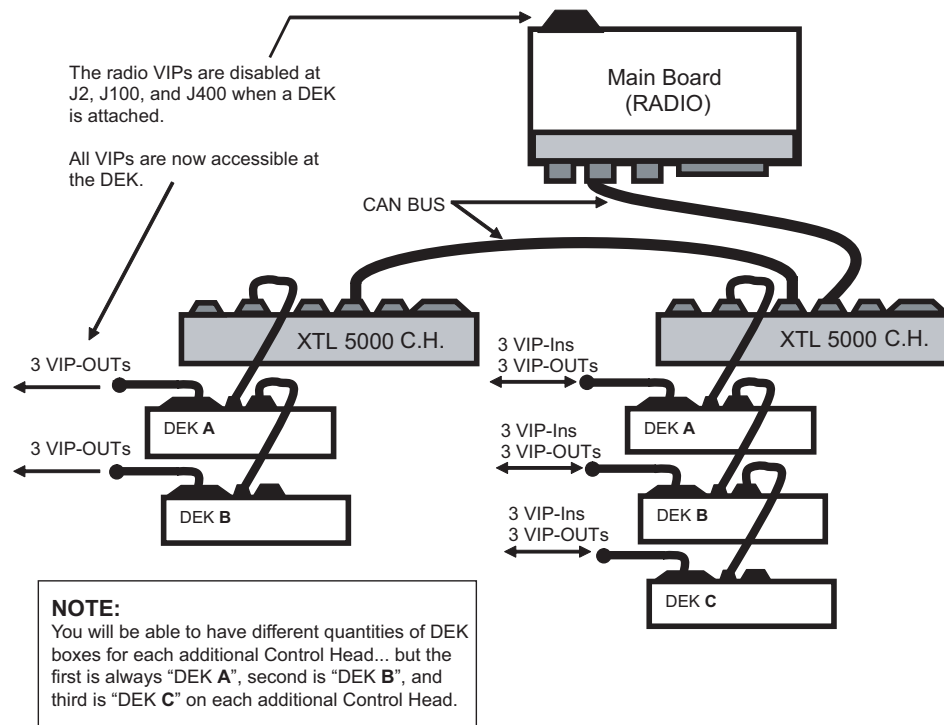


Figure 3-13. Multiple Control Heads + DEK +VIPs

### 3.4.14 CAN Termination Section

Three CAN transceivers SN65HVD230 in the Control Head & TIB side are differentially paired to minimize on interference to the CAN Bus Network. Each CAN transceiver is dedicated to transfer only one type of signal ([Figure 3-15](#)):

- CAN1 or CAN Audio – Transmit & receive audio signal from brick (Remote Mode).
- CAN2 or CAN Data – Interchange data & control between control head & brick in remote mode.
- CAN3 or CAN PWR – Send/Receive ON/OFF/RESET signal to/from the transceiver and control head.

The CAN architecture requires that a termination resistor be connected only at the two end-points of the CAN bus. The CAN cable contains a jumper that will ground a “detect pin” at the CAN connectors. Logic within the auto-termination circuit determines how many cables are attached and enables or disables the termination resistors, for each of the three twisted pairs. [Figure 3-14](#) shows a system with terminations enabled on both the O5 control head and the radio transceiver. The O3 control head has the termination resistors enabled at all times, since it is always an end-node. The radio+TIB and O5+CHIB could be daisy-chained, so the termination had to be toggled when not an end node.

**NOTE:** The remote mount cables are able to be connected to either the left CAN connector or to the right CAN connector. That is why they have the same connector number, with the letter L and R next to the connector to indicate Left or Right CAN connector. It is not recommended to have CAN cables attached but dangling free at one end, during operation.

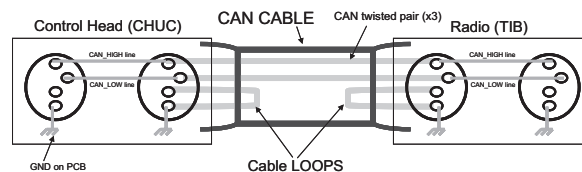


Figure 3-14. Two node system with CAN terminations enabled.

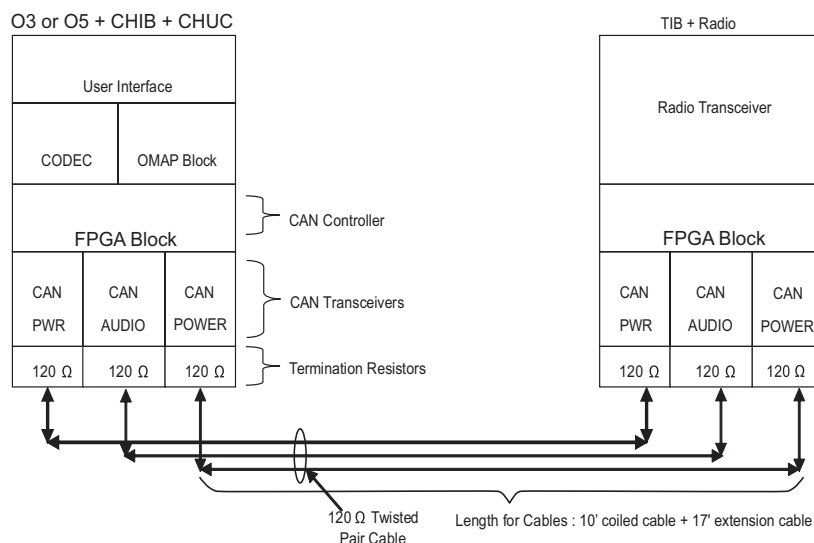


Figure 3-15. CAN Termination Section.

### 3.5 O5 Control Head Interface Board (CHIB)

The O5 Control Head Interface Board (CHIB) is used to provide functionality and connectivity between the CHUC, the transceiver, and the Control Head. In order for remote-mount operation to function, the Synchronous Serial Interface (SSI) used to communicate between the control head and the transceiver in a Dash-mount configuration is converted on the CHIB to a Controller Area Network (CAN) protocol. The CHIB accomplishes this conversion using an FPGA. This CAN data is then sent down the remote cable from the CHIB, through the CHUC, into the TIB, and finally into the transceiver. The CHIB also provides an audio power amplifier for driving a speaker, a USB host, two USB device transceivers, and an auto-termination circuit to terminate the CAN bus.

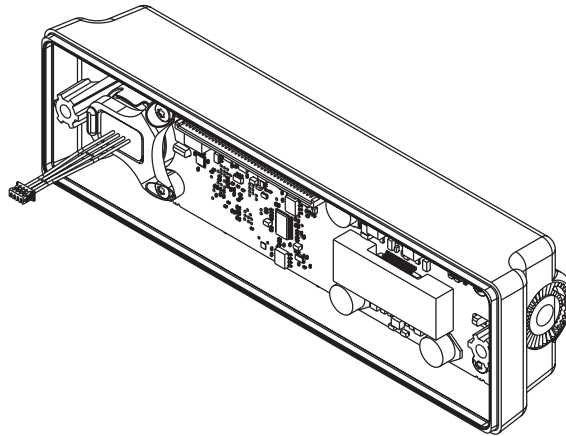


Figure 3-16. Control Head Interface Board (CHIB)

#### 3.5.1 FPGA Section

Please refer to [Section 3.4.2 on page 3-10](#).

#### 3.5.2 Audio Section

The audio section is comprised of a class D audio amplifier with associated feedback circuitry and output filters, a code/decode (CODEC) IC, and a programmable attenuator. In receive mode, receive audio is sent to the FPGA via CAN. The FPGA converts the signal to SSI and routes the signal to the CODEC. The CODEC converts the signal to analog. Three analog CODEC outputs are used. Two are used for record out and ear jack out. These levels are fixed, meaning the volume control does not affect the output level. The third CODEC output is routed through a programmable attenuator, then into an A/D conversion stage and on to the class D audio amplifier. The differential output is short circuit protected and is capable of driving loads down to 3.2 ohms. In transmit mode, the analog signal from the microphone is routed through the control head to the CHIB. A microphone can also be connected to the AUX\_MIC input in the 26-pin accessory connector. These signals are feed into the CODEC, which selects the correct input, based on commands from the main board, and converts the signal to SSI. The SSI signal is sent to the FPGA, which performs the SSI to CAN conversion and sends the signal to the transceiver. The microphone bias circuit for both the GCAI MIC\_HI line and the accessory connector AUX\_MIC input are located on the CHIB.

### 3.5.3 Power Section

A+ is routed through the Control Head Universal Connector (CHUC) and CHIB to the control head. An over-voltage transorb and fuse are located on the CHIB that protects the control head and CHIB from over-voltage transients and, to a limited extent, reverse-voltage wiring. A+ is routed to the control head 5 volt regulator input. The 5 volt output is then routed back to the CHIB and powers four voltage regulators. The four supply voltages are 1.5 volts, 1.8 volts, 2.85 volts, and 3.3 volts. The CHIB also has one un-switched 3.3 volt supply that is feed directly from A+. Finally, SW\_B+ from the control head is used to drive two additional regulators: an 11 volt regulator, which is used by the audio PA and a 9 volt regulator used to supply bias voltage to the MIC\_HI and AUX\_MIC inputs.

### 3.5.4 Connectivity Section

The CHIB contains two USB transceivers. One is used for USB host and the other is for USB device. The USB device connection is through J100, the 26-pin connector. The USB host connection is through J500, a 4-pin water-sealed connector. All other connectivity signals route from the control head, through the CHIB, and out through the connectors on the CHUC.

## 3.6 O5 Control Head Universal Connector (CHUC)

The O5 Control Head Universal Connector (CHUC) is a separate board which provides multiple functions to the control head and CHIB. Connectors J100, J200, J300, and J400 are all physically located on the CHUC, as well as the ESD protection for these pins. The signals from these connectors travel out through a 70-pin connector into the CHIB. The CHUC contains the switching circuitry that allows VIPS to exist at either J100 or J400, depending on cable detection. The voltage level shifting required for the duality of either DEK or VIP\_IN / VIP\_OUT at J400 is handled on the CHUC as well as a circuit to protect against reverse voltage wiring of the control head.

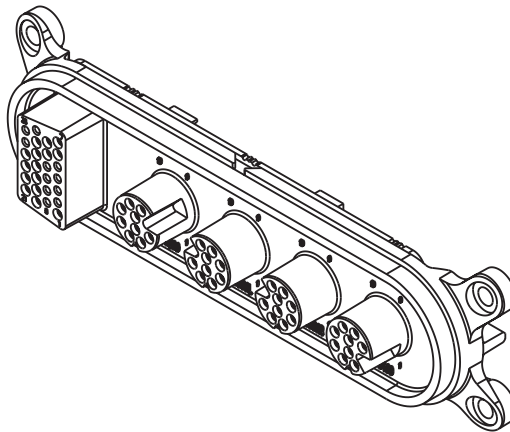


Figure 3-17. Control Head Universal Connector (CHUC)



### 3.7 Transceiver Interface Board (TIB)

The Transceiver Interface Board (TIB) provides connectivity between the remote CAN cable and either the mid-power or high-power transceiver. Opposite to that of the CHIB, the TIB must convert the CAN protocol back to Synchronous Serial Interface (SSI) via an FPGA, which is sent to the microprocessor. There also exists a legacy accessory interface J600, as well as the GCAI J700 connection for data programming and secure key-loading of the transceiver. The TIB universal connector attaches directly to the board, so all ESD protection to the TIB circuitry and to the transceiver's front connector is located throughout the TIB. Power-ON, Power-OFF, and RESET of the transceiver is accomplished using an ATMEL AVR microcontroller to toggle SWB+ as determined by commands from the Transceiver or from a remote device, such as a control head, connected to the CAN bus.

The TIB contains an audio CODEC which interfaces to the FPGA to route audio to accessories attached to the TIB and a control line back to the transceiver. A charge pump boost circuit is designed to allow RS232 functionality at the GCAI when A+ is below nominal value. During normal operation, the boost circuit is disabled. The TIB is capable of using either RS232 or USB at its GCAI connector. The limitation on using USB is a mid-power transceiver only has USB interface located at the back of the radio. Therefore, only on a high-power transceiver will have GCAI USB functionality. The TIB contains an identical auto-termination circuit to that used on the CHIB. Finally, the TIB contains the circuitry to drive relays via VIP\_OUT paths and detect levels via VIP\_IN paths.

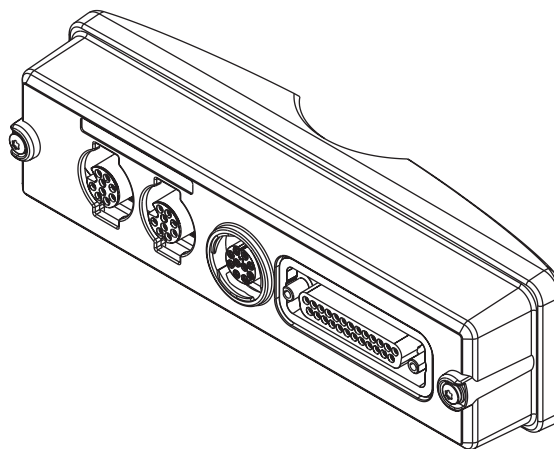


Figure 3-18. Transceiver Interface Board (TIB)

#### 3.7.1 Quick Disconnect Circuit

The theory of the quick disconnect circuit, located in the TIB, is to provide immediate muting of all speaker audio by forcing the radio to reset when a control head's CAN cable is disconnected from the TIB or from an extension cable that is attached to the TIB. After the disconnection, if there are no other control heads attached via CAN to the TIB, the radio may be programmed to automatically turn itself off (approximately 20seconds after the radio reset). This programming is done via the CPS by check marking the "Control Head(s) Required for Power Up" field. Note that if this field is NOT checked, the radio will apply its normal power up rules (e.g., ignition) to determine whether to stay on or to power-off after the reset. The "Control Head(s) Required for Power Up" field is typically 'check marked' in a configuration that has a single O3 control (that is attached to an extension cable that is attached to the TIB) where it is desired that the radio immediately mute all speaker audio and ultimately power-off when the O3 control head is disconnected.

- If the field is 'check marked', then at least one controlhead must be present for the radio to remain powered-on after it resets. For example, if you only had 1 control head, and it is removed, the radio will be powered-off after reset. If you had 2 control heads, and only 1 is removed, then after reset, the radio will monitor the ignition line and compare to the ignition CPS setting to determine if it will remain powered-on, or power-off. If you had 2 control heads, and you remove both, the radio will be powered-off after reset.
- If the field is 'blank' (typical usage), then quick disconnect is not activated. For example, if you only had 1 control head, and it is removed, then after reset, the radio will monitor the ignition line and compare to the ignition CPS setting to determine if it will remain powered-on, or power-off. If you had 2 control heads, and only 1 is removed, the radio will be powered-on after reset. If you had 2 control heads, and you remove both, the radio will monitor the ignition line and compare to the ignition CPS setting to determine if it will remain powered-on, or power-off.

## 3.8 Analog Mode of Operation

### 3.8.1 Receive Operation

When the radio is receiving, the signal comes from the antenna through the RF PA output network located in the power amplifier section to the front-end receiver assembly. The signal is then filtered, amplified, and mixed with the first local oscillator signal generated by the receiver voltage controlled oscillator (VCO). The resulting intermediate-frequency (IF) signal is fed to the IF circuitry where it is again filtered and amplified. This amplified signal is passed to the back-end receiver IC where it is mixed with the second local oscillator to create the second IF at 2.25 MHz. The analog IF is processed by an analog-to-digital (A/D) converter located within the digital back-end IC, where it is converted to a digital bit stream and decimated down to an I/Q digital sample. This digital signal is then passed on to the DSP, where filtering and discrimination are performed in the software. For a voice signal, the DSP routes the digital voice data to the Codec for conversion to an analog signal. The signal passes through a Log Pot to the audio power amplifier, which drives the speaker. For signaling information, the DSP decodes the message and passes it to the microprocessor.

### 3.8.2 Transmit Operation

When the radio is transmitting, microphone audio is passed to the gain control circuit, and then to the Codec, where the signal is digitized. The Codec passes digital data to the DSP, where pre-emphasis and low-pass (splatter) filtering is done. The DSP returns this signal to the Codec and the signal is then passed to a digital-to-analog (DAC) converter where it is reconverted into an analog signal. The signal is then passed through a switched capacitor filter IC and then to the synthesizer IC as a modulation signal for the transmitter voltage controlled oscillators. Also, transmitted signaling information is accepted by the DSP from the microprocessor, coded appropriately, and passed to the Codec, which handles it the same as a voice signal. Modulation information is passed to the synthesizer along the modulation line. A modulated carrier is provided to the RF power amplifier, which transmits the signal under dynamic power control.

## 3.9 ASTRO Mode of Operation

In the ASTRO mode (digital mode) of operation, the transmitted or received signal is limited to a discrete set of deviation levels, instead of continuously varying. The receiver handles an ASTRO-mode signal identically to an analog-mode signal up to the point where the DSP decodes the received data.

In the ASTRO receive mode, the DSP uses a specifically defined algorithm to recover information.

In the ASTRO transmit mode, microphone audio is processed the same as in the analog mode with the exception of the algorithm the DSP uses to encode the information. This algorithm will result in deviation levels that are limited to discrete levels.

### 3.10 Radio-Frequency Power Amplifier (RF PA) & Output Network (ON)

The RF PA is a three-stage power amplifier consisting of discrete LDMOS transistors:

- Controlled stage
- Driver stage
- Final stage

The RF PA is followed by the ON section, consisting of discrete circuitry with the following functions:

- Antenna switch
- Harmonic filter
- Power detector

#### 3.10.1 Gain Stages

The controlled stage consists of a two-stage, integrated amplifier with external matching, which amplifies the input signal from the VCO buffer and provides drive to the driver stage. Power is controlled via gate bias to both internal stages, and drain bias is supplied via K9.1V. The driver stage has a fixed gate bias. Drain bias is supplied by the A+ (battery) voltage in the VHF and 700/800 radio. Drain bias is supplied by DRV\_9.3V in the UHF Range 1 and Range 2 radio. The driver stage drives the final stage consisting of two transistors operating in parallel. Both devices have separate, fixed gate biases, and their drain biases are supplied by the A+ voltage. The output of the final stage feeds the antenna switch, which routes the RF PA to the harmonic filter/power detector/antenna and isolates the RX front-end in transmit mode. Antenna switch routes antenna/power detector/harmonic filter to RX and isolates TX in RX mode. Mode is determined via K9.1V. The harmonic filter is a low-pass filter that attenuates harmonics generated by the RF PA in transmit mode and provides additional receive selectivity in receive mode.

#### 3.10.2 Power Control

Power is regulated by an automatic-level control (ALC) circuit. The transmitter ALC consists of a distributed power detector with a detection diode, buffer/amplifier, digital-to-analog converter (DAC), and loop integrator. During transmission, the RF PA gain and output power is adjusted by a control voltage. The power detector senses incident power transferred to the antenna via a directional coupler whose signal is converted to a DC voltage by the detection diode. This DC voltage is buffered/amplified and then added to the DAC voltage which is then compared to a fixed voltage reference. The carrier power level is set by adjusting the DAC voltage while monitoring the output power, which is saved in radio memory.

#### 3.10.3 Circuit Protection

RF PA final-stage drain current, RF PA final-stage temperature, RF PA control voltage, and battery voltage are sensed by the power-control circuitry. If a fault condition is detected, the control voltage is reduced, which cuts back the output power to a level that is safe for the particular conditions.

#### 3.10.4 DC Interconnect

The DC connector at the edge of the board carries the A+ supply for the entire board. This supply is routed directly to the controller and transmitter circuitry for both direct supply and regulating additional supplies. The radio chassis is grounded through the PCB screws and also via direct contact to the board. The dash mount control head receives the A+ supply through the 50-pin flex connector.

## 3.11 VHF Receiver Overview

The primary duties of the receiver circuits are to detect, filter, amplify, and demodulate RF signals in the presence of strong interfering noise and unintended signals. The receiver contains the following blocks:

- Front-end (preselectors and LNAs)
- Mixer
- IF
- Back-end

### 3.11.1 Receiver Front-End

The VHF receiver operates in the frequency range of 136 to 174 MHz. The primary function of the receiver front-end is to optimize the rejection of the image frequency and other out-of-band frequencies while providing low-noise amplification of the received signal. The front-end uses discrete fixed-tuned filters and discrete bipolar LNAs. The front-end has two possible configurations: standard mode, which provides the best intermodulation performance, and the optional pre-amp mode, which provides improved sensitivity at the cost of slightly reduced intermodulation performance. The front-end line-up for standard mode is: a switched 15 dB attenuator for AGC purposes, a 4-pole Chebyshev bandpass filter, a low-noise amplifier, and a 6-pole elliptic bandpass filter. In pre-amp mode, a 2-pole highpass filter and an additional LNA is added between the attenuator and the first bandpass filter by means of discrete PIN diode switches.

### 3.11.2 Mixer

The receiver front-end signal is fed into a discrete double-balance mixer where it is down-converted into an intermediate frequency (IF) of 109.65 MHz. The mixer consists of two balun transformers and a octo-quad diode ring. This configuration allows high-level local oscillator (LO) injection, thus maximizing intermodulation performance. The mixer is driven by the receiver injection buffer, which consists of three discrete stages designed to provide a stable injection level of +20 dBm. The synthesizer performs high-side injection to the mixer.

### 3.11.3 IF Circuitry

The crystal filters provide IF selectivity and out-of-band signal protection to the back-end IC. The use of two 2-pole crystal filters centered at 109.65 MHz, which are isolated from one another by a discrete IF amplifier, enable the receiver to meet specifications for gain, close-in intermodulation rejection, adjacent channel selectivity, and second-image rejection.

### 3.11.4 Receiver Back-End

The output of the IF circuit is fed directly to the back-end receiver IC. This uses a variable-bandwidth bandpass sigma-delta architecture. It is capable of down-converting analog, as well as digital, RF protocols into a baseband signal, which is then transmitted over the Synchronous Serial Interface (SSI) bus. It also converts the 109.65 MHz signal from the IF section down to 2.25 MHz using a second LO frequency, which is produced by the second LO VCO. This VCO runs at 107.4 (low-side injection) or 111.9 MHz (high-side injection). The choice of frequency depends on known spurious interference related to the programmed received frequency.

## 3.12 UHF Receiver Overview

The primary duties of the UHF receiver circuits are to detect, filter, amplify, and demodulate RF signals in the presence of strong interfering noise and unintended signals. The receiver contains the following blocks:

- Front-end (preselectors and LNAs)
- Mixer
- IF
- Back-end

### 3.12.1 Receiver Front-End

The UHF receiver operates in the frequency range of 380 to 470 MHz for Range 1 and 450 to 520 MHz for Range 2. The primary function of the receiver front-end is to optimize the rejection of the image frequency and other out-of-band frequencies while providing low-noise amplification of the received signal. The front-end uses a discrete bipolar LNA, a discrete varactor-tuned filter, a microwave monolithic IC (MMIC) LNA, and a discrete fixed-tuned image filter. The front-end has two possible configurations: standard mode, which provides the best intermodulation performance, and the optional pre-amplifier mode, which provides improved sensitivity at the cost of slightly reduced intermodulation performance. The front-end lineup for standard mode is a varactor-tuned filter, MMIC LNA, and image filter. In pre-amp mode, an additional LNA is added by means of discrete PIN diode switches.

### 3.12.2 Mixer

The receiver front-end signal is fed into a discrete double-balance mixer, where it is down-converted into an intermediate frequency (IF) of 109.65 MHz. The mixer consists of two balun transformers and a diode ring. This configuration allows high-level local oscillator (LO) injection, thus maximizing intermodulation performance. The mixer is driven by the receiver injection buffer, which consists of a two-stage LDMOS amplifier designed to provide a stable injection level of +23 dBm. The synthesizer performs high-side injection to the mixer.

### 3.12.3 IF Circuitry

The crystal filters provide intermediate frequency selectivity and out-of-band signal protection to the back-end IC. The use of two 2-pole crystal filters centered at 109.65 MHz, which are isolated from one another by a discrete IF amplifier, enable the receiver to meet specifications for gain, close-in intermodulation rejection, adjacent channel selectivity and second-image rejection.

### 3.12.4 Receiver Back-End

The output of the IF circuit is fed directly to the back-end receiver IC. This IC uses a variable-bandwidth bandpass sigma-delta architecture. It is capable of down-converting analog, as well as digital, RF protocols into a baseband signal, which is then transmitted over the Synchronous Serial Interface (SSI) bus. It also converts the 109.65 MHz signal from the IF section down to 2.25 MHz using a second LO frequency, which is produced by the second LO VCO. This VCO runs at 107.4 (low-side injection) or 111.9 MHz (high-side injection). The choice of frequency depends on known spurious interference related to the programmed received frequency. The default is low-side injection.

## 3.13 700–800 MHz Receiver Overview

The receiver circuits primary duties are to detect, filter, amplify, and demodulate RF signals in the presence of strong interfering noise and unintended signals. The receiver is broken down into the following blocks:

- Front-end (preselector and LNA)
- Mixer
- IF
- Back-end

### 3.13.1 Receiver Front-End

The 700–800 MHz receiver front-end operates in two bands. The primary function of the receiver front-end is to optimize image rejection and selectivity while providing the first conversion. The front-end uses ceramic-filter technology and includes a wideband, monolithic amplifier. The first filter is a dual-switched filter that reduces the image frequency response and limits some of the out-of-band interference. The second filter following the monolithic Low Noise Amplifier (LNA) provides additional image rejection.

### 3.13.2 Mixer

The receiver front-end signal is fed to the monolithic Mixer IC where it is down converted to an IF of 73.35 MHz. The mixer is designed to provide low conversion loss and high intermodulation performance. The mixer is driven by the receiver injection buffer, a two-stage discrete IC design used with the receiver VCO to efficiently drive the mixer over a wide temperature range with minimum power variation. The injection buffer provides 15 dBm to the mixer. The VCO performs low-side injection for the 800 MHz band and high-side Injection for the 700 MHz band. The design maintains temperature stability, low insertion loss, and high out-of-band rejection.

### 3.13.3 IF Circuitry

The crystal filters provide IF selectivity and out-of-band signal protection to the back-end IC. Two 2-pole crystal filters centered at 73.35 MHz that are isolated from one another by a stable, moderate-gain amplifier are used to meet the receiver specifications for gain, close-in intermodulation rejection, adjacent-channel selectivity, and second-image rejection.

### 3.13.4 Receiver Back-End

The output of the IF circuit is fed directly to the back-end receiver IC. This IC uses a variable-bandwidth bandpass Sigma-Delta architecture. It is capable of down-converting analog as well as digital RF protocols into a baseband signal transmitted on the Synchronous Serial Interface (SSI) bus. It also converts the 73.35 MHz signal from the IF section down to 2.25 MHz using a second LO frequency of 71.1 MHz or 75.6 MHz. The second LO VCO is tuned to 71.1 MHz (low side) or 75.6 MHz (high side injection). The choice of frequency depends on known spurious interference related to the programmed received frequency.

### 3.14 VHF Frequency Generation Unit (FGU)

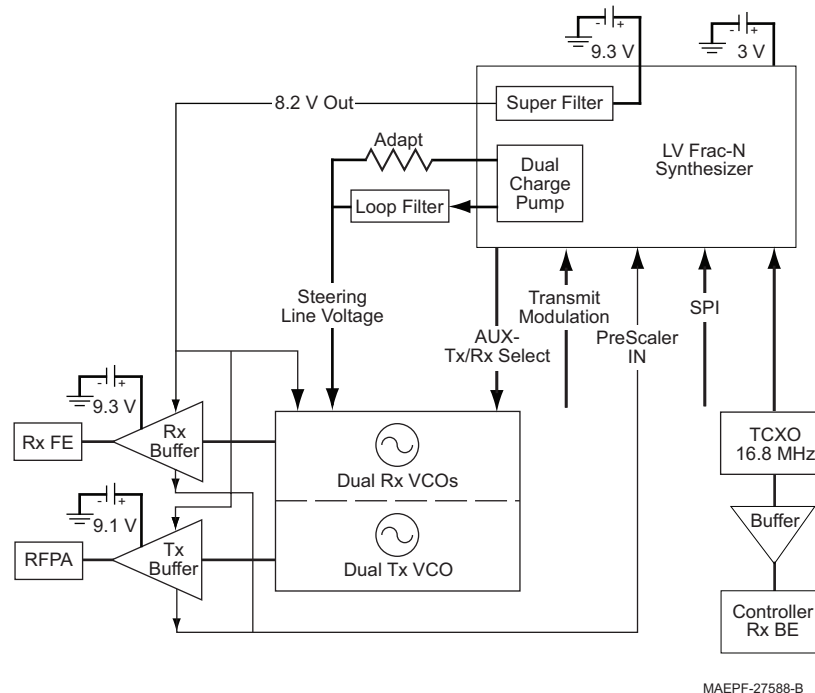


Figure 3-19. VHF Frequency Generation Unit Diagram

The VHF frequency generation unit (FGU) (Figure 3-19) consists of the following:

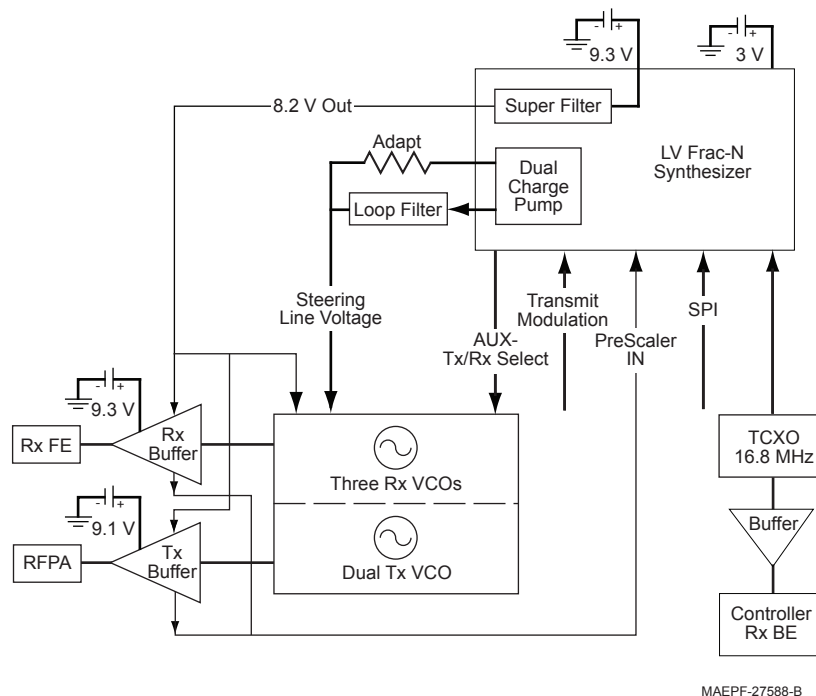
- Fractional-N synthesizer IC
- 16.8 MHz reference oscillator IC
- Four voltage-controlled oscillator (VCO) circuits (two receive and two transmit VCOs)
- VCO buffer/amplifier circuits
- Associated circuitry

The reference oscillator IC provides a frequency standard to the fractional-N synthesizer IC, the back-end receiver IC, and the controller section. The synthesizer turns on one of the four VCOs (determined by mode and frequency of operation) and tunes it to the receiver (RX) local oscillator (LO) or transmitter (TX) carrier frequency.

The VCOs employ a Colpitts configuration with a bipolar transistor. The LC tank circuit's capacitive portion consists of varactor diodes and a coupling capacitor. The inductive portion consists of High Q inductors for TX VCO and High Q inductors for RX VCOs. The varactor changes the oscillator frequency when the DC voltage of the steering line changes. The output of each oscillator is coupled to a transistor for impedance buffering, and its output is coupled to respective TX/RX buffer amplifiers.

In TX mode, the transmitter VCO output is coupled to a buffer before being injected into the power amplifier (see “3.10 Radio-Frequency Power Amplifier (RF PA) & Output Network (ON)” on page 3-24). In RX mode, the receiver VCO output is buffered and amplified with a transistor circuit before going to the injection amplifier. The outputs of the last VCO buffer transistors are split into two paths. One path feeds back to the synthesizer prescaler; the other path is injected into the TX power amplifier, or RX injection amplifier. The output of the RX injection amplifier provides the proper signal level for the LO port of the RX front-end mixer (see “3.11 VHF Receiver Overview” on page 3-25).

### 3.15 UHF Frequency Generation Unit (FGU)



*Figure 3-20. UHF Frequency Generation Unit Diagram*

The UHF frequency generation unit (FGU) (Figure 3-20) consists of the following:

- Fractional-N synthesizer IC
- 16.8 MHz reference oscillator IC
- Five voltage-controlled oscillator (VCO) circuits (three receive and two transmit VCOs)
- VCO buffer/amplifier circuits
- Associated circuitry

The reference oscillator IC provides a frequency standard to the fractional-N synthesizer IC, the back-end receiver IC and to the controller section. The synthesizer turns on one of the five VCOs (determined by mode and frequency of operation) and tunes it to the receiver (RX) local oscillator (LO) or transmitter (TX) carrier frequency.

The VCOs employ a Colpitts configuration with a bipolar transistor. The LC tank circuit's capacitive portion consists of varactor diodes and a coupling capacitor. The inductive portion consists of coaxial resonators for TX VCOs and coaxial resonators for RX VCOs. The varactor changes the oscillator frequency when the DC voltage of the steering line changes. The output of each oscillator is coupled to a transistor for impedance buffering, and its output is coupled to respective TX/RX buffer amplifiers.

In TX mode, the transmitter VCO output is coupled to a two-stage buffer before being injected into the power amplifier (see “[3.10 Radio-Frequency Power Amplifier \(RF PA\) & Output Network \(ON\)](#)” on page 3-24). In RX mode, the receiver VCO output is buffered and amplified with a three-stage transistor circuit before going to the injection amplifier. The outputs of the last VCO buffer transistors are split into two paths. One path feeds back to the synthesizer prescaler; the other path is injected into the TX power amplifier, or RX injection amplifier. The output of the RX injection amplifier provides the proper signal level for the LO port of the RX front-end mixer (see “[3.12 UHF Receiver Overview](#)” on page 3-26).



### 3.16 700–800 MHz Frequency Generation Unit (FGU)

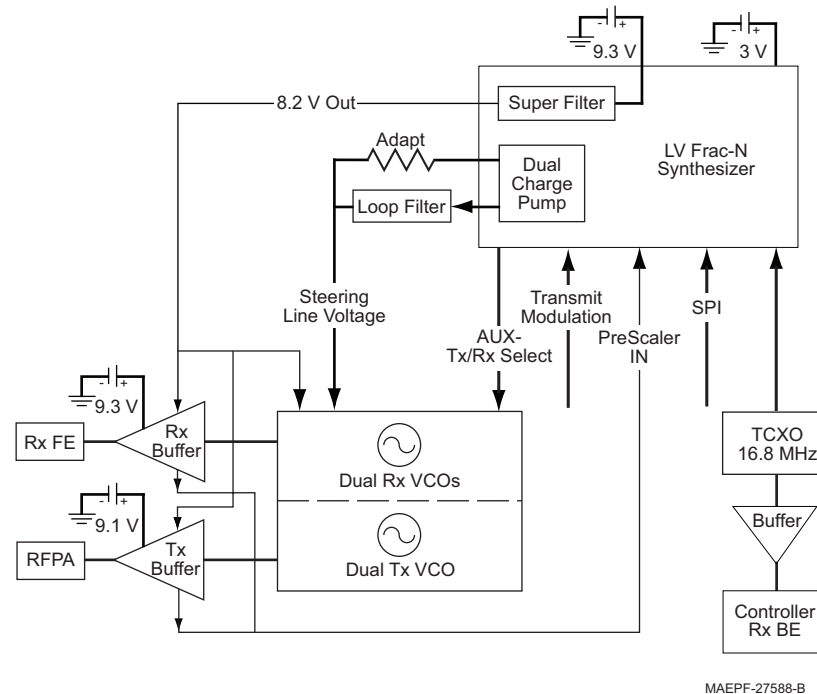


Figure 3-21. 700–800 MHz Frequency Generation Unit Diagram

The 700–800 MHz frequency generation unit (FGU) (Figure 3-21) consists of the following:

- Fractional-N synthesizer IC
- 16.8 MHz reference oscillator IC
- Two voltage-controlled oscillator (VCO) modules (receive and transmit, containing two VCOs each)
- VCO buffer/amplifier circuits
- Associated circuitry

The reference oscillator IC provides a frequency standard to the fractional-N synthesizer IC, the back-end receiver IC, and the controller section. The synthesizer turns on one of the four VCOs (determined by mode and band of operation) and tunes it to the receiver (RX) local oscillator (LO) or transmitter (TX) carrier frequency.

The voltage-controlled oscillator (VCO) module employs a Colpitts configuration with two bipolar stages in a common-base, common-collector configuration. The LC tank circuit's capacitive portion consists of a varactor diode, coupling capacitor, and a laser-trimmed capacitor for frequency adjustment. The inductive portion consists of microstrip transmission line resonators for TX VCO and coaxial resonators for RX VCO. Tuning is performed by the module manufacturer and is not field adjustable. The varactor changes the oscillator frequency when the DC voltage of the steering line changes. The output of the common base is coupled to the second transistor for impedance buffering, and its output is coupled to respective TX/RX buffer amplifiers.

In TX mode, the transmitter VCO output is coupled to a three-stage buffer before being injected into the power amplifier (see [“3.10 Radio-Frequency Power Amplifier \(RF PA\) & Output Network \(ON\)” on page 3-24](#)). In RX mode, the receiver VCO output is buffered and amplified with a two-stage transistor/microwave monolithic IC (MMIC) circuit. The output of the first-stage transistor is split into two paths. One path feeds back to the synthesizer prescaler; the other path is injected into the second-stage MMIC. The output of the MMIC provides the proper signal level for the LO port of the RX front-end mixer (see [“3.13 700–800 MHz Receiver Overview” on page 3-27](#)).

The super filter supplies the voltage to the first two stages of the TX buffer and to the first-stage transistor of the RX buffer/amplifier. The voltage for the third stage of the TX buffer is supplied by a keyed 9.1 V source to conserve current drain while the radio is receiving. The second-stage MMIC of the RX buffer/amplifier is supplied by a 9.3 V regulator.

## Notes

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## Chapter 4 Test Equipment, Service Aids, and Tools

### 4.1 Recommended Test Equipment

The list of equipment contained in [Table 4-1](#) includes most of the standard test equipment required for servicing Motorola mobile radios, as well as several unique items designed specifically for servicing this family of radios. The *Characteristics* column is included so that equivalent equipment can be substituted; however, when no information is provided in this column, the specific Motorola model listed is either a unique item or no substitution is recommended.

*Table 4-1. Recommended Motorola Test Equipment*

Motorola Model Number	Description	Characteristics	Application
R-1439 or  R-1440 (See <a href="#">Table 4-2</a> for plug-in elements)	BIRD Wattmeter  BIRD Wattmeter	Power range: 100 mW to 100W, 2 MHz to 1GHz, UHF-F connector Power range: 100 mW to 100W, 2 MHz to 1GHz, N-female connector	Transmitter power measurements
R-1611	Dual-Channel 100 MHz Oscilloscope (Agilent)	Two-channel, 100MHz bandwidth, 200 Msample rate/sec., 2MB memory/channel	Waveform measurements
R-2670 (with options, as applicable)	System Analyzer	This item will substitute for items with an asterisk (*).	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment

[Table 4-2](#) contains a listing of the plug-in elements that are available for the BIRD wattmeters listed in [Table 4-1](#).

*Table 4-2. Wattmeter Plug-In Elements*

Power	25-60 MHz	50-125 MHz	100-250 MHz	200-500 MHz	400-1000 MHz
5W	---		0180305F29	0180305F38	0180305F46
10W	---	0180305F22	0180305F30		0180305F47
25W	0180305F15	0180305F23	0180305F31	0180305F40	0180305F48
50W	0180305F16	0180305F24	0180305F32	0180305F41	0180305F49
100W	0180305F17	0180305F25	0180305F33	0180305F42	0180305F50
250W	0180305F18	0180305F26	0180305F34	0180305F43	0180305F51
500W	0180305F19	0180305F27	0180305F35	0180305F44	0180305F52
1000W	0180305F20	0180305F28	0180305F36	0180305F45	0180305F53

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Table 4-3 contains a listing of non-Motorola test equipment recommended for servicing mobile radios.

Table 4-3. Recommended Non-Motorola Test Equipment

Model Number	Description	Application
	1:1 Audio Transformer	Audio measurement (audio PA must NOT be grounded)
Agilent 6552	Power Supply (0-20 V, 0-25 A)	Mobile radio power supply
Agilent 8901	Modulation Analyzer	Frequency, reference oscillator deviation and compensation measurements
Agilent 8903	Audio Analyzer	Audio signal-level, SINAD, and distortion measurements
Fluke 45	Bench-Top Digital Multimeter	AC/DC voltage and current measurements
Fluke 187 or 189	Handheld Digital Multimeter (True RMS, AC, AC+DC, dB)	AC/DC voltage and current measurements
Fluke 190 Series	Handheld Oscilloscope (60-200 MHz Bandwidth, 2.5 GS/sec, Built-in 500-Count True RMS Multimeter)	Waveform measurements
HP E4430	Digital I/Q Modulation Signal Source	Signal source for transmit and receive digital tests
Weinschel 49 30 43	30 dB RF Attenuator	For tests that require a modulation analyzer or wattmeter

## 4.2 Service Aids and Recommended Tools

Refer to the tables in this section for a listing and description of the service aids and tools designed specifically for servicing this family of radios, as well as the more common tools required to disassemble and properly maintain the radio. These kits and/or parts are available from the Motorola parts division offices listed in [Appendix A. Replacement Parts Ordering](#).

Table 4-4. Service Aids for XTL 5000 Board-Level Troubleshooting

Motorola Part Number	Description	Application
RVN4185_	Customer Programming Software and Tuner Software	Programming and radio alignment software on CD
HKN6182_	High Power GCAI Cable Adapter for Keyloader	Used for keyloading XTL 5000 High Power
HKN6183_	2-wire GCAI RS232 Programming Cable	Used for programming XTL 5000 Mid or High Power through control head or TIB GCAI connector. Can also be used for data terminal applications.
HKN6184_	GCAI USB Programming Cable	Used for programming XTL 5000 High Power through the TIB. Used for programming XTL 5000 Mid or High Power through the Control Head. Can also be used for data terminal applications.
HKN6122_	4-wire RS232 data cable	Used for programming XTL 5000 Mid or High Power through TIB J600. Can also be used for data terminal applications
HKN6160_	6' 4-wire RS232 data cable	Data cable and can be used as programming cable for XTL 5000 Mid Power. Can also be used for data terminal applications.
HKN6161_	20' 4-wire RS232 data cable	Data cable and can be used as programming cable for XTL 5000 Mid Power. Can also be used for data terminal applications.
HKN6163_	6' USB data cable	Data cable and can be used as programming cable for XTL 5000 Mid Power through J2. Can also be used for data terminal applications.
HKN6172_	15' USB data cable	Data cable and can be used as programming cable for XTL 5000 Mid Power through J2. Can also be used for data terminal applications. This cable will not work correctly in a dash mount radio configuration (attaching cable at J2) unless an emergency jumper wire is installed inside the 26pin connector of this cable.

Table 4-5. Recommended Motorola Tools for Board-Level Troubleshooting

Motorola Part Number	Tools and Supplies
0180386A82	Anti-static grounding kit
8180384N71	Chassis eliminator (Mid Power)
8180384S04	Chassis eliminator (High Power)
1185984D01	Electromagnetic Interference (EMI) metallic shielding tape, or equivalent
0180320B16	Magnetic screwdriver set with bits
3085651A01	Mini-UHF to N-type adapter cable
6686119B01	Plastic scraping tool

Table 4-5. Recommended Motorola Tools for Board-Level Troubleshooting (Continued)

Motorola Part Number	Tools and Supplies
6680163F01	Removal and insertion tool
RSX4043	Roto-Torq adjustable torque driver

Table 4-6. Recommended Non-Motorola Tools for Board-Level Troubleshooting

Part Number	Tools and Supplies
	Flat-blade screwdriver
	Small, flat-blade screwdriver
MA-800G	Solder aid, (black stick), Hexacon Electric Co.
	Torx® T10 and T20 bits

### 4.3 XTL 5000 Field Programming and Equipment

The ASTRO family of radios can be aligned and programmed in the field. This requires specific equipment and special instructions. Refer to the online help in Customer Programming Software (RVN4185).

The XTL 5000 radios use a flash-memory device to store information about frequencies, squelch codes, signaling codes, time-out timer durations, and other parameters.

The XTL 5000 radios can be programmed in the field any number of times without removing the flash memory from the radio.

To program the radio, connect RS232 cable HKN6183\_ or USB cable HKN6184\_ to the control head Global Core Accessory Interface (GCAI) connector. This is the 10-pin connector to which the microphone is commonly attached. The GCAI connector is below the volume knob and to the left of the LCD display. Refer to the *CPS Programming Installation Guide* (Motorola part number 6881095C44) for installation and setup procedures for the software.

Once the computer is connected to the radio, the prompts provided by the programming software can be followed. The following items, available through the Radio Products Services Division (except the computer), are required when programming XTL 5000 radios.

Table 4-7. XTL 5000 Radio Field-Programming Items

Type or Part Number	Description
Programming Cable	Used to connect radio directly to the computer, <a href="#">Table 4-4</a> .
Computer, IBM or IBM PC-compatible	
RVN4185 Customer Programming Software and Tuner Software	This software enables you to program the radio's features and align its parameters.

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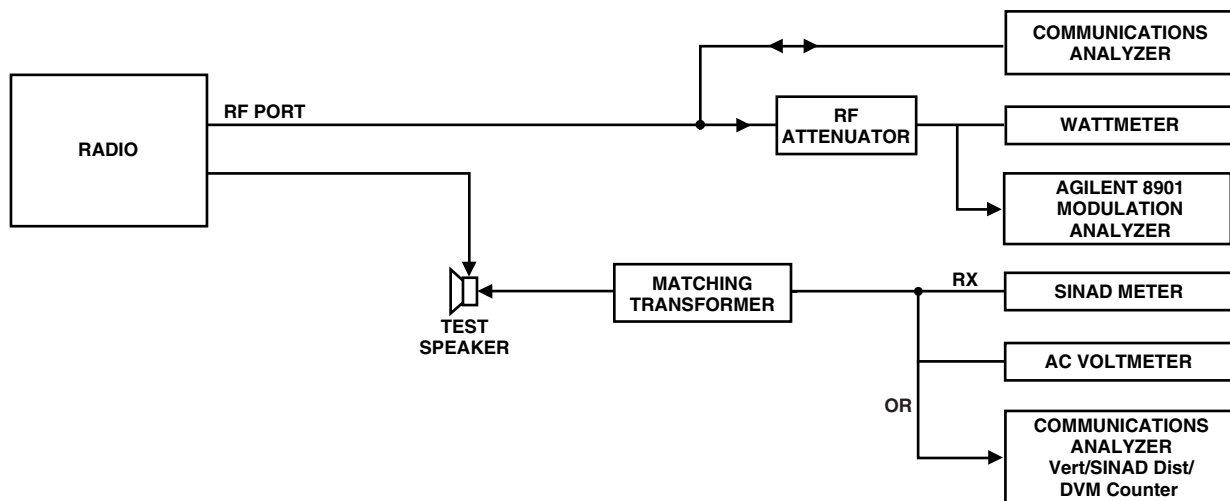
## Chapter 5 Performance Checks

### 5.1 Introduction

This section covers performance checks used to verify that the radio meets published specifications. The recommended test equipment listed in [Chapter 4](#) approaches the accuracy of the manufacturing equipment, with a few exceptions. Accuracy of the equipment must be maintained in compliance with the manufacturer's recommended calibration schedule.

### 5.2 Test Setup

The equipment required for XTL 5000 radio performance checks is connected as shown in the following diagram.



MAEPF-27656-O

Figure 5-1. Performance Checks Test Setup

### 5.3 Test Mode



Caution

Be sure to transmit into a series load when keying a radio under test (e.g. 30dB RF pad). Failure to do so can result in test equipment damage.

#### 5.3.1 Entering Test Mode

1. To enter test mode, turn the radio on.
  2. Within 10 seconds after Self Test is complete, press the **Home** button five times in succession (for O5 Control Head) or press the **Side Button 2** five times in succession (for O3 Control Head)
  3. The radio shows a series of displays that will give information regarding various version numbers and subscriber-specific information. The displays are described in [Table 5-1 on page 5-2](#).
-



Table 5-1. Test-Mode Displays

Display Name	Description	Appears
SERVICE	Indicates the radio has entered test mode	Always
HOST VERSION	The version of the transceiver firmware	Always
DSP VERSION	The version of the transceiver DSP firmware	Always
EMC Secure Version	Version of the encryption hardware	When the radio is secure- equipped
Encryption Firmware	Firmware version for encryption	When the radio is secure- equipped
Encryption Type 1	Type of encryption being used	When the radio is secure- equipped
Encryption Type 2	Type of encryption being used	When the radio is secure- equipped
CH VERSION	The version of Control head firmware	Always
Auxiliary Control Head	Firmware version for the auxiliary control head	When an auxiliary control head is present
Siren Version	Firmware version for the siren	When a siren is present
VRS Version Number	Firmware version for the VRS	When VRS is present
MODEL NUMBER	The radio's model number, as programmed in the codeplug	Always
SERIAL NUMBER	The radio's serial number, as programmed in the codeplug	Always
ESN	Electronic Serial Number	Always
ROM Size	Memory capacity of the flash port	Always
FLASHCODE	The FLASHcodes, programmed as a part of the radio's codeplug	Always
RF BAND	The frequency band of the transceiver	Always
TUNING VER	The codeplug tuning version	Always
PROCESSOR VER	The version of the transceiver microprocessor	Always

**Note:** All displays are temporary and expire without any user intervention. If the information is longer than the physical length of the control head display, it wraps around to the next display. After the last display, RF TEST is displayed.

4. Turn the **Mode** Rotary Knob for O5 Control Head. The test mode menu, CH TEST, is displayed.
5. Pressing the **Home** button enters the RF test mode. The display shows 1 CSQ, indicating test frequency 1, Carrier SQuelch mode.
6. For the O3 Control Head, pressing the **Monitor** button enables toggling between RF TEST and CH TEST.
7. To select, press the **EMERG** button. If the RF TEST is selected, display Shows 1 CSQ, indicating test frequency 1, Carrier SQuelch mode.
8. Go to the **RF Test Mode** section.

### 5.3.2 RF Test Mode

A special routine called **RF TEST MODE** or *air test* has been incorporated into the radio.

1. For the O5 Control Head, enter the RF test mode by pressing the **Home** button when the test mode menu RF TEST is displayed. If RF TEST is not displayed, use the **Mode** knob to scroll through the test mode menu until RF TEST is displayed.
2. For the O3 Control Head, enter the RF test mode by pressing the **EMERG** button when the test mode menu RF TEST is displayed. If RF TEST is not displayed, use the **Monitor** button to toggle between RF TEST and CH TEST.
3. For the O5 Control Head, press the **Home** button to move the cursor back and forth between the frequency and signaling type (See [Table 5-2](#) on this page and [Table 5-3 on page 5-4](#)). Use the **Mode** knob to scroll through the available selections.
4. For the O3 Control Head, press the **Monitor** button to select Channel Spacing (12.5Khz or 25kHz), press the **Side Button 1** to change signaling type and press **Side Button 2** to change frequency.

Table 5-2. Test Frequencies

Test Channel	VHF	UHF R1	UHF R2	700–800 MHz
TX #1	136.0125	380.025	450.025	762.0125
RX #1	136.0625	380.075	450.075	762.0625
TX #2	140.7625	391.475	455.825	769.0125
RX #2	140.8125	391.425	455.625	769.0625
TX #3	145.5125	408.975	463.675	775.9875
RX #3	145.5625	408.925	463.625	775.9375
TX #4	150.2625	424.9375	473.375	794.0125
RX #4	150.3125	424.9875	473.325	851.0625
TX #5	154.9375	425.025	484.975	805.9875
RX #5	154.9875	425.075	484.925	860.0625
TX #6	155.0125	436.025	485.025	806.0125
RX #6	155.0625	436.075	485.075	860.0625
TX #7	159.7625	455.875	490.825	823.9875

Table 5-2. Test Frequencies (Continued)

Test Channel	VHF	UHF R1	UHF R2	700–800 MHz
RX #7	159.8125	455.825	490.875	869.9375
TX #8	164.5125	469.9375	496.625	851.0125
RX #8	164.5625	469.9875	496.675	851.0625

Table 5-3. Signaling Types

Display	Modulation	Demodulation	Type
CSQ	None	None	Carrier Squelch
TPL	192 Hz	192 Hz	Private-Line
AST	1200 Hz	N/A	ASTRO (digital)
USQ	None	None	Open Squelch

When in the transmit test mode, DTMF modulation produces a sidetone in the speaker. All signaling types will continually modulate the transmitted signal for detection/measurement by external instruments.

### 5.3.3 O3 Control Head Test Mode

The control head test mode is part of the diagnostics built into the radio and is entered through the front-panel programming sequence. This test mode allows you to perform button and display tests to verify proper operation.

1. Enter the control head test mode by pressing the **ON/OFF** button while holding down the 1 and 3 button of the keypad. Wait till Standalone Mode is displayed and release the 1 and 3 Button of the keypad. CH Firmware version, CH FPGA version, CH Flashzap version and CH Board version will be displayed before being able to be in Factory Test.
2. Once in Factory Test menu, pressing any buttons will activate the following tests:
  - LED test (green, red and yellow)
  - Backlight test (Off, Medium and On)
  - LCD test (4 borders test)

For the Hook Up test that follows right after the LCD test has been completed, place the Hook Up and remove the Hook Up until Hook Off is shown. Hit any button after this to activate the 32 buttons test that will test the Keypad Buttons, Side Buttons and Top Buttons. All the 32 Buttons notations will be displayed on the LCD and once the corresponding button is pressed, the notation will disappear from the LCD. After all 32 Buttons are pressed, Test Completed will be displayed and to turn the CH off, press the ON/OFF button once.

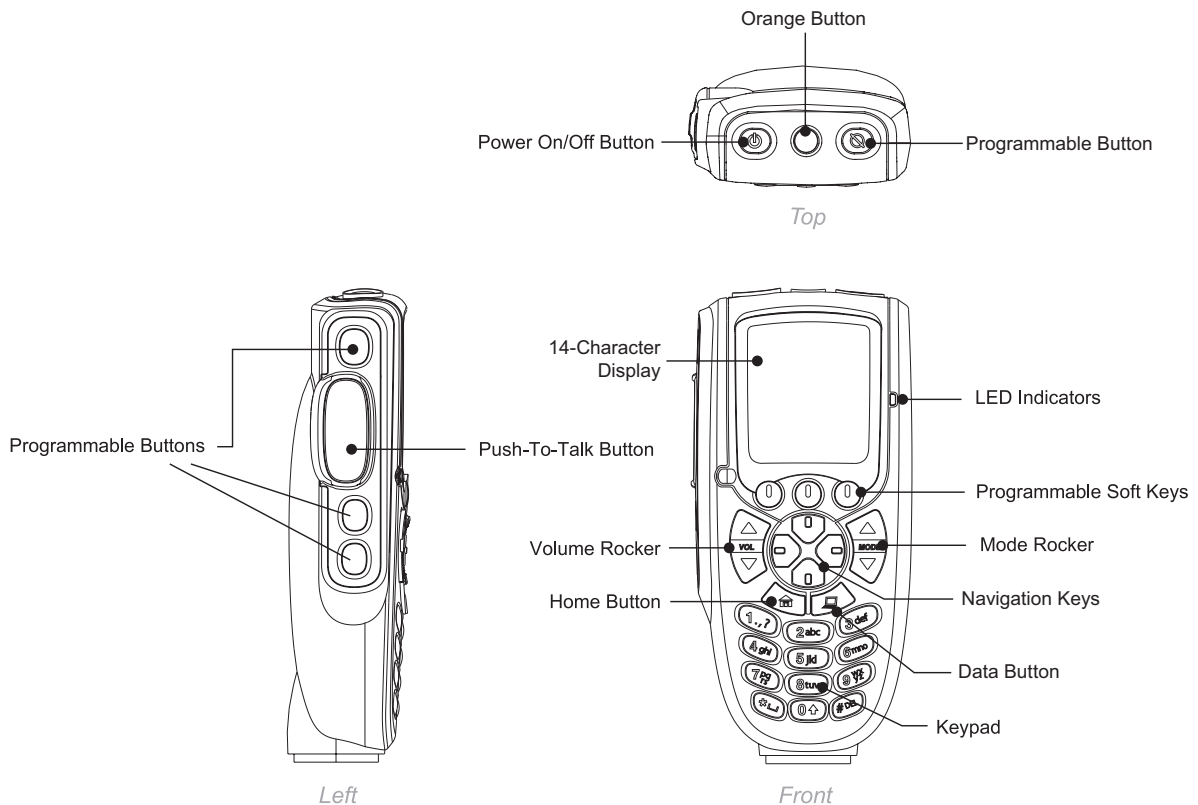


Figure 5-2. XTL 5000 O3 Control Head

3. Turn the radio off and back on to exit test mode and return to normal radio operation.

### 5.3.4 O5 Control Head Test Mode

The control head test mode is part of the diagnostics built into the radio and is entered through the front-panel programming sequence. This test mode allows you to perform button and display tests to verify proper operation.

1. Enter the control head test mode by pressing the **Home** button when the test mode menu, CH TEST, is displayed. If CH TEST is not displayed, use the **Mode** knob to scroll through the test mode menu until CH TEST is displayed.

**NOTE:** Once **CH TEST** has been selected by pressing **Home**, turning the **Mode** knob will not change the control head test mode back to the RF test mode. You must turn the radio off and reenter the RF test mode as described earlier.

2. When the control head test mode has been selected, all the icons across the top of the LCD are displayed briefly and the indicator LED's on the right side will light briefly. At this point, pressing any of the control head buttons or turning the knobs will display the button or knob ID and the value of the button or knob. The value of a button is 1 for a press and 0 for a release. The power button functions normally and will turn the control head off.

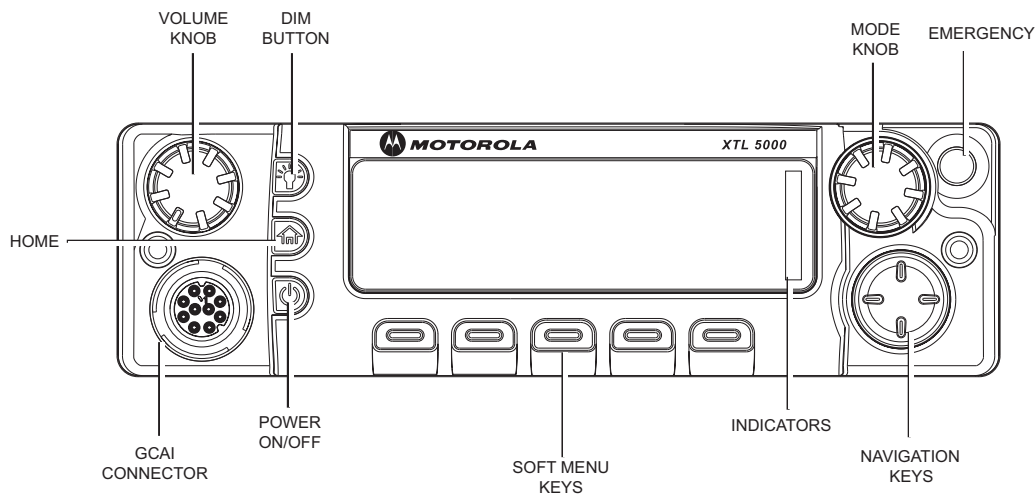


Figure 5-3. XTL 5000 Control Head

- Turn the radio off and back on to exit test mode and return to normal radio operation.

## 5.4 Receiver Performance Checks

Table 5-4. Receiver Performance Checks

Test Name	System Analyzer	Radio	Test Condition	Comments
Reference Frequency	Mode: PWR MON 1st channel test frequency* Monitor: Frequency error Input at RF In/Out	TEST MODE, 1 CSQ output at antenna	Press and hold PTT switch.	Maximum Frequency error is ± 2.5 PPM for VHF ± 2.0 PPM for UHF ± 1.5 PPM for 700/800
Rated Audio	Mode: GEN Output level: 1.0 mV RF 1st channel test frequency* Mod: 1 kHz tone at 3 kHz deviation Monitor: DVM: AC Volts	TEST MODE, 1 CSQ	Release PTT switch.	Set volume control to 6.3 Vrms across the 3.2 ohm speaker
Distortion	As above, except to distortion	TEST MODE, 1 CSQ	Release PTT switch.	Distortion ≤ 3.0%
Sensitivity (SINAD)	As above, except SINAD, lower the RF level for 12 dB SINAD	TEST MODE, 1 CSQ	Release PTT switch.	RF input to be < 0.25 μV
Noise Squelch Threshold (only radios with conventional system need to be tested)	RF level set to 1 mV RF	TEST MODE, 1 CSQ	Release PTT switch.	Set volume control to 3.16 Vrms across the speaker.
	As above, except change frequency to a conventional system. Raise RF level from zero until radio unsquelches.	Out of TEST MODE; select a conventional system	Release PTT switch.	Unsquelch to occur at < 0.25 μV

\* Test frequencies are listed in [Table 5-2](#).

## 5.5 Transmitter Performance Checks

Table 5-5. Transmitter Performance Checks

Test Name	System Analyzer	Radio	Test Condition	Comments
Reference Frequency	Mode: PWR MON 1st channel test frequency** Monitor: Frequency error Input at RF In/Out	TEST MODE, 1 CSQ	Press and hold PTT switch.	Maximum Frequency error is ± 2.5 PPM for VHF ± 2.0 PPM for UHF ± 1.5 PPM for 700/800
Power RF	As above	TEST MODE, 1 CSQ	Press and hold PTT switch.	Refer to the Radio Specifications in the front of the manual.
Voice Modulation	Mode: PWR MON 1st channel test frequency** atten to -70, input to RF In/Out, Monitor: DVM, AC Volts Set 1 kHz Mod Out level for 0.025 Vrms at test set, 80 mVrms at dummy microphone or load box input	TEST MODE, 1 CSQ	Press and hold PTT switch.	Deviation: VHF, UHF, 700- 800 MHz: ≥ 3.6 kHz but ≤ 5.0 kHz See the Detailed Service Manual for test equipment descriptions.
Voice Modulation External Microphone	Mode: PWR MON 1st channel test frequency** atten to -70, input to RF In/Out	TEST MODE, 1 CSQ, output at antenna	Connect external microphone. Press and hold PTT.	Press PTT switch on microphone and say "four" loudly into the radio mic. Measure deviation: VHF, UHF, 700- 800 MHz: ≥ 3.8 kHz but ≤ 5.0 kHz See the Detailed Service Manual for test equipment descriptions.
PL Modulation (radios with conventional, clear mode, coded squelch operation only)	Change frequency to 1st channel test frequency**; B/W to narrow	TEST MODE, 1 TPL	Remove modulation input from dummy microphone or load box. Press and hold PTT switch.	Deviation: VHF, UHF, 700- 800 MHz: ≥ 500 Hz but ≤ 1000 Hz See the Detailed Service Manual for test equipment descriptions.

Table 5-5. Transmitter Performance Checks (Continued)

Test Name	System Analyzer	Radio	Test Condition	Comments
Talkaround Modulation (radios with conventional, clear mode, talkaround operation only)	Change frequency to conventional talkaround frequency. Mode: PWR MON deviation, attenuation to -70, input to RF In/Out Monitor: DVM, AC Volts Set 1 kHz Mod Out level for 80 mVrms at dummy microphone or load box.	Conventional talkaround personality (clear mode operation) 1 CSQ	Press and hold PTT switch.	Deviation: VHF, UHF, 700-800 MHz: >= 3.8 kHz but <= 5.0 kHz See the Detailed Service Manual for test equipment descriptions.
Talkaround Modulation (radios with conventional, secure mode, talkaround operation only) *	Change frequency to conventional talkaround frequency. Mode: PWR MON deviation, attenuation to -70, input to RF In/Out Monitor: DVM, AC Volts Mod: 1 kHz out level for 80 mVrms at dummy microphone or load box.	Conventional talkaround personality (secure mode operation). Load key into radio 1 sec.	Press and hold PTT switch.	Deviation: VHF, UHF, 700-800 MHz: >= 3.6 kHz but <= 4.4 kHz See the Detailed Service Manual for test equipment descriptions.

\* The secure mode, talkaround modulation test is only required for radios that do not have clear mode talkaround capability.

\*\* Test frequencies are listed in [Table 5-2](#).


Select **Tuner** from the **Start** menu. To read the radio, use the **File** → **Read Device** menu or click on . [Figure 6-2 on page 6-2](#) illustrates how the alignment screens are organized. To access a screen, double-click on the desired screen name in the **Tuner** menu.



Figure 6-2 shows the tuner main menu screen for VHF and 700–800 MHz radios.

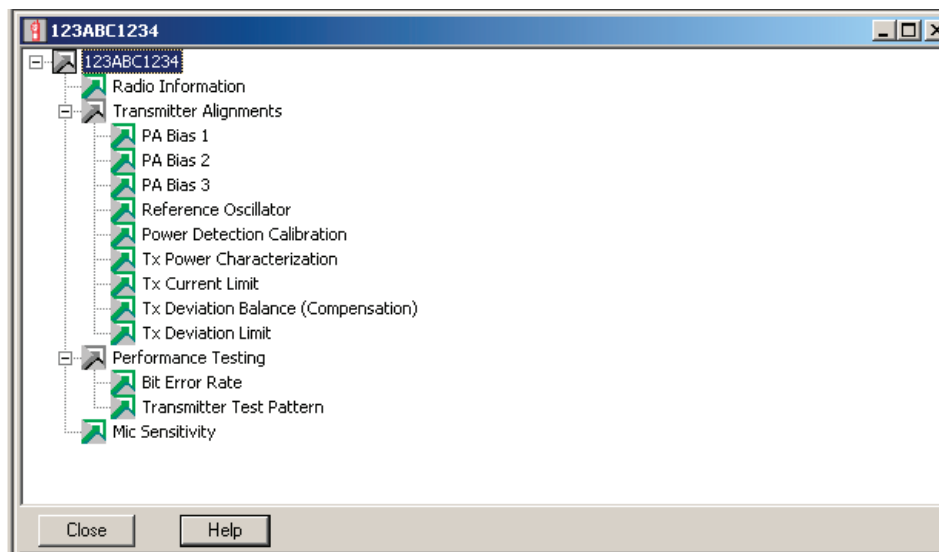


Figure 6-2. VHF/700-800 MHz Tuner Main Menu

Figure 6-3 shows the tuner main menu screen for UHF radios. For UHF radios, the receiver front-end filter alignment is added.

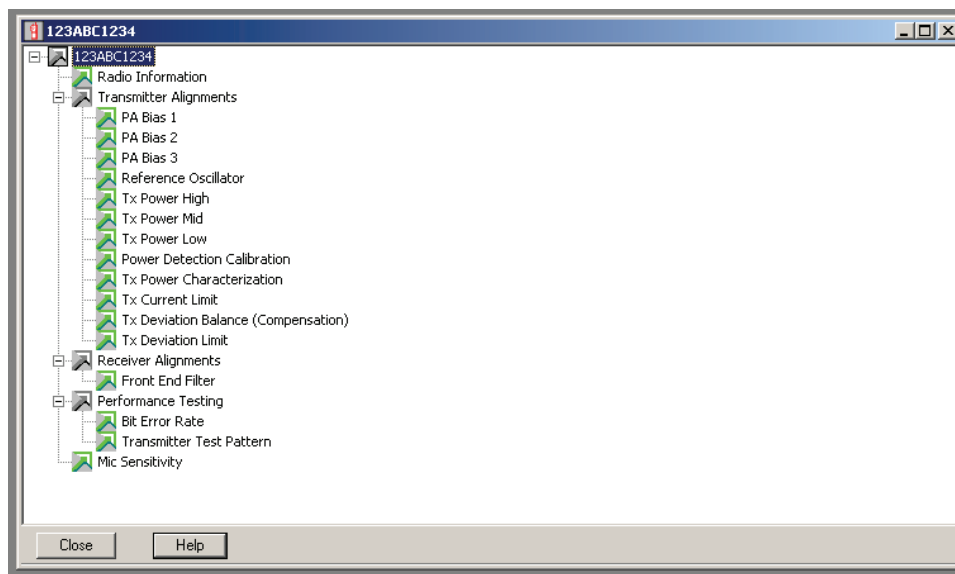


Figure 6-3. UHF Tuner Main Menu



**Caution**

Do NOT switch radios in the middle of any alignment procedure. Always left-click the **Close** button on the screen to return to the Tuner Main Menu screen before disconnecting the radio. Improper exits from the Alignment screens might leave the radio in an improperly configured state and result in seriously degraded radio or system performance.

The alignment screens utilize the “softpot,” an analog **SOFT**ware-controlled **POT**entiometer used for adjusting all transceiver alignment controls.

Each alignment screen provides the ability to increase or decrease the softpot value by using the **slider** or the **spin buttons** ( ▲ and ▼ ), or by entering the new value from the keyboard. A graphical scale on the display indicates the minimum, maximum, and proposed value of the softpot.

## 6.3 Radio Information

Figure 6-4 shows a typical Radio Information screen. All of the data appearing here is informational and cannot be changed.

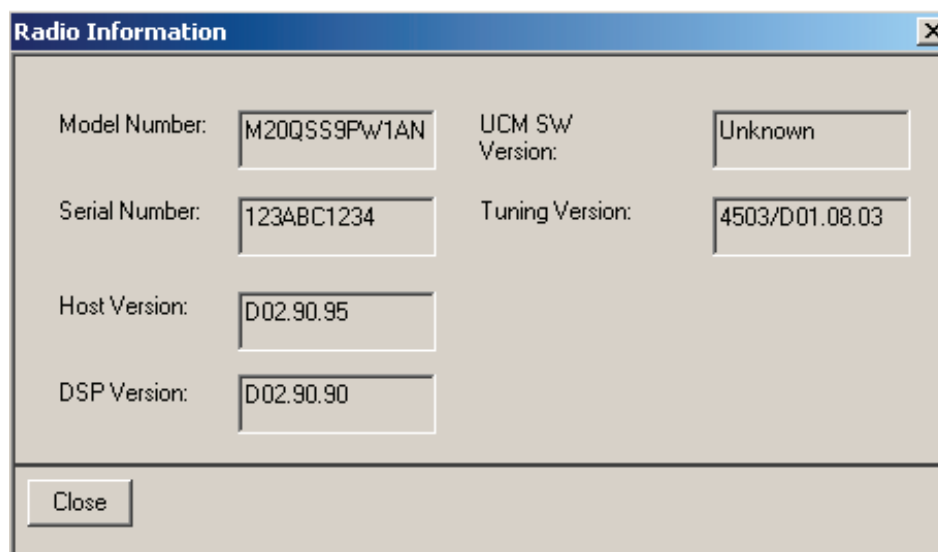


Figure 6-4. Radio Information Screen

## 6.4 Transmitter Alignments

### 6.4.1 PA Bias 1 Alignment

**NOTE:** This alignment is required after replacing (or servicing) the transceiver board. This alignment is not required for UHF range 2 because for UHF range 2 PA Bias 1 is a fixed value.

The PA Bias 1 alignment procedure adjusts the drain bias current in one of the RF power amplifier devices.

Table 6-1. PA Bias 1 Alignment RF Power Amplifier Devices

Band/Power Level	Device
VHF 50 W/25 W	Final
VHF 100 W	Final1
UHF R1 40 W	Final1
UHF R1 100 W	Final1
UHF R2 45 W	Final1
700–800 MHz 35 W	Final1

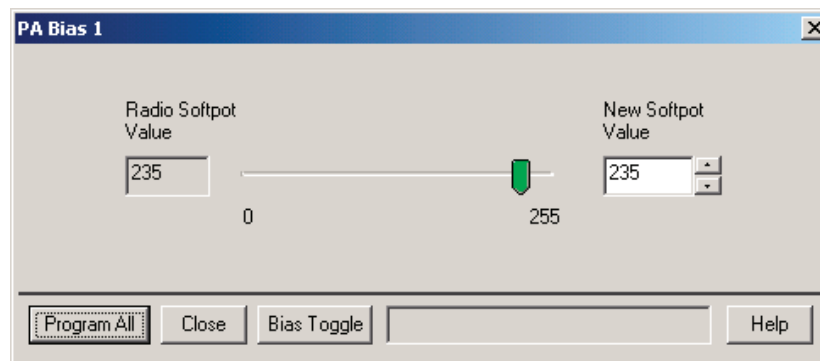
**NOTE:** The antenna port should be terminated with a 50-ohm load while tuning.

1. Set the power supply voltage as indicated in [Table 6-2](#). Set power supply current limit to 3 A.

*Table 6-2. Power Supply Voltage Settings*

Band/Power Level	Supply Voltage (V)	Supply Current Limit (A)
VHF 50 W/25 W	13.6	3
VHF 100 W	13.4	3
UHF R1 40 W	13.6	3
UHF R1 100 W	13.4	3
UHF R2 45 W	13.6	3
700–800 MHz 35 W	13.6	15

2. Select **PA Bias 1** from the Tuner Main Menu. When the screen is displayed, the radio enters a special bias tune mode, and radio current increases by approximately 100 mA.



*Figure 6-5. PA Bias 1 Alignment Screen*

3. Read baseline current from current meter on power supply.
4. Add baseline current to device bias current to calculate target current.

*Table 6-3. PA Bias 1 Alignment Device Bias Current*

Band/Power Level	Device Bias Current (mA)
VHF 50 W/25 W	400
VHF 100 W	75
UHF R1 40 W	200
UHF R1 100 W	500
UHF R2 45 W	NA
700–800 MHz 35 W	250

5. Left-click the **Bias Toggle** button to apply bias to gate of device.
6. Adjust softpot value until target current is achieved within  $\pm 10\%$

7. Left-click the **Bias Toggle** button to remove bias from gate of device.
8. Left-click the **Program All** button to save tuned value.
9. Left-click **Close** button to close the screen and return to the Tuner Main Menu.

### 6.4.2 PA Bias 2 Alignment

**NOTE:** This alignment is required after replacing (or servicing) the transceiver board. This alignment is not required for UHF range 2 because for UHF range 2 PA Bias 2 is a fixed value.

The PA Bias 2 alignment procedure adjusts the drain bias current in one of the RF power amplifier devices.

*Table 6-4. PA Bias 2 Alignment Amplifier Devices*

Band/Power Level	Device
VHF 50 W/25 W	Driver
VHF 100 W	Final2
UHF R1 40 W	Final2
UHF R1 100 W	Final2
UHF R2 45 W	Final2
700–800 MHz 35 W	Final2

**NOTE:** The antenna port should be terminated with a 50-ohm load while tuning.

1. Set the power supply voltage as indicated in [Table 6-5](#). Set power supply current limit to 3 A.

*Table 6-5. Power Supply Voltage Settings*

Band/Power Level	Supply Voltage (V)	Supply Current Limit (A)
VHF 50 W/25 W	13.6	3
VHF 100 W	13.4	3
UHF R1 40 W	13.6	3
UHF R1 100 W	13.4	3
UHF R2 45 W	13.6	3
700–800 MHz 35 W	13.6	15

2. Select **PA Bias 2** from the Tuner Main Menu. When the screen is displayed, the radio enters a special bias tune mode, and radio current increases by approximately 100 mA.

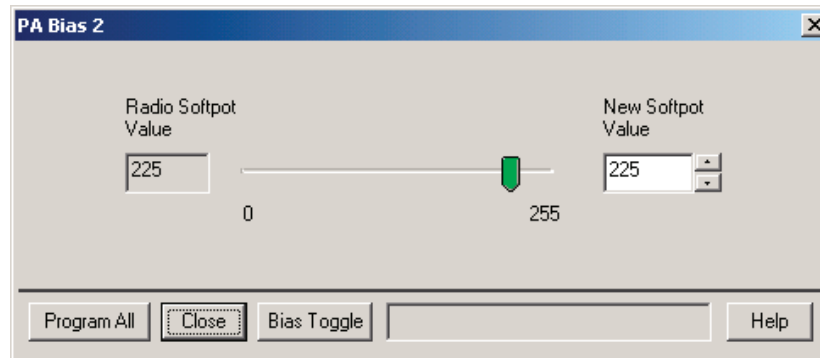


Figure 6-6. PA Bias 2 Alignment Screen

3. Read baseline current from current meter on power supply.
4. Add baseline current to device bias current to calculate target current.

Table 6-6. PA Bias 2 Alignment Device Bias Current

Band/Power Level	Device Bias Current (mA)
VHF 50 W/25 W	150
VHF 100 W	75
UHF R1 40 W	200
UHF R1 100 W	500
UHF R2 45 W	NA
700–800 MHz 35W	250

5. Left-click the **Bias Toggle** button to apply bias to gate of device.
6. Adjust softpot value until target current is achieved within  $\pm 10\%$
7. Left-click the **Bias Toggle** button to remove bias from gate of device.
8. Left-click the **Program All** button to save tuned value.
9. Left-click **Close** button to close the screen and return to the Tuner Main Menu.

### 6.4.3 PA Bias 3 Alignment

**NOTE:** This alignment is required after replacing (or servicing) the transceiver board.

The PA Bias 3 alignment procedure adjusts the drain bias current in one of the RF power amplifier devices.

*Table 6-7. PA Bias 3 Alignment Amplifier Devices*

Band/Power Level	Device
VHF 50 W/25 W	NA
VHF 100 W	Driver
UHF R1 40 W	Driver
UHF R1 100 W	Driver
UHF R2 45 W	Driver
700–800 MHz 35 W	Driver

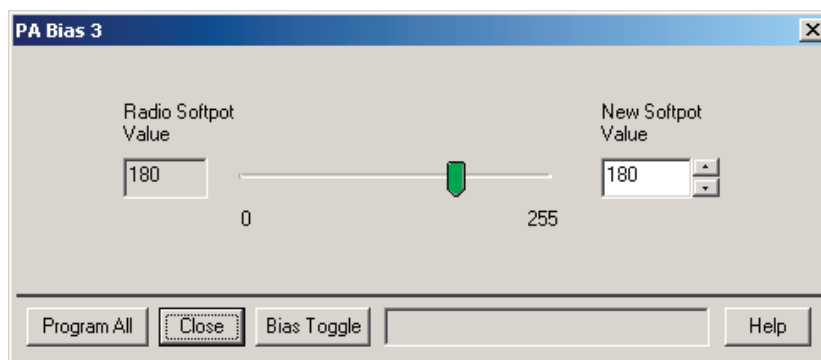
**NOTE:** The antenna port should be terminated with a 50-ohm load while tuning.

1. Set the power supply voltage as indicated in [Table 6-8](#). Set power supply current limit to 3 A.

*Table 6-8. Power Supply Voltage Settings*

Band/Power Level	Supply Voltage (V)	Supply Current Limit (A)
VHF 50 W/25 W	NA	NA
VHF 100 W	13.4	3
UHF R1 40 W	13.6	3
UHF R1 100 W	13.4	3
UHF R2 45 W	13.6	3
700–800 MHz 35 W	13.6	15

2. Select **PA Bias 3** from the Tuner Main Menu. When the screen is displayed, the radio enters a special bias tune mode and radio current increases by approximately 100 mA.



*Figure 6-7. PA Bias 3 Alignment Screen*

3. Read baseline current from current meter on power supply.

4. Add baseline current to device bias current to calculate target current.

*Table 6-9. PA Bias 3 Alignment Device Bias Current*

Band/Power Level	Device Bias Current (mA)
VHF 50 W/25 W	NA
VHF 100 W	150
UHF R1 40 W	30
UHF R1 100 W	150
UHF R2 45 W	30
700–800 MHz 35 W	100

5. Left-click the **Bias Toggle** button to apply bias to gate of device.
6. Adjust softpot value until target current is achieved within  $\pm 10\%$
7. Left-click the **Bias Toggle** button to remove bias from gate of device.
8. Left-click the **Program All** button to save tuned value.
9. Left-click **Close** button to close the screen and return to the Tuner Main Menu.

#### 6.4.4 Reference Oscillator Alignment

Radios are shipped from the factory with a worst-case frequency error of  $\pm 200$  Hz for the VHF frequency band,  $\pm 300$  Hz for the UHF Range 1 and UHF Range 2 frequency bands and  $\pm 600$  Hz for the 700–800 MHz bands. These specifications are tighter than the more stringent FCC requirements of  $\pm 2.5$  ppm for the VHF,  $\pm 2.0$  ppm for the UHF bands and  $\pm 1.5$  ppm for the 700–800 MHz bands.

For radios that have been in storage for over six months from the factory ship date, the reference oscillator should be checked when the radio is initially deployed to the field. It is strongly recommended that the reference oscillator be checked every time the radio is serviced or at least once a year, whichever comes first.

The crystal contained in the reference oscillator naturally drifts over time due to its aging characteristic. Periodic (annual) adjustment of the reference oscillator is important for proper radio operation.

Improper adjustment can result in both poor performance and interference with other users operating on adjacent channels.

This test can be done with either the R-2670 Communication Analyzer or the Agilent 8901 Modulation Analyzer.

- Initial setup using the R-2670 Communication Analyzer:
  - RF Control: MONITOR
  - B/W: WB
  - Freq: RSS frequency under test
  - Attenuation: 20 dB
  - Mon RF in: RF I/O
  - Meter: RF Display
  - Mode: STD
  - Input Level: uV or W

- Display: Bar Graphs
- Squelch: Mid-range or adjust as necessary
- Initial setup using the Agilent 8901 Modulation Analyzer:
  - Press the green Automatic Operation button on the analyzer.
  - Press the **FREQ** key.
  - Type **7.1**, followed by the **SPCL** button, to set the 8901 Modulation Analyzer for maximum accuracy.
- 1. Select **Reference Oscillator** from the Tuner Main Menu (Figure 6-8).

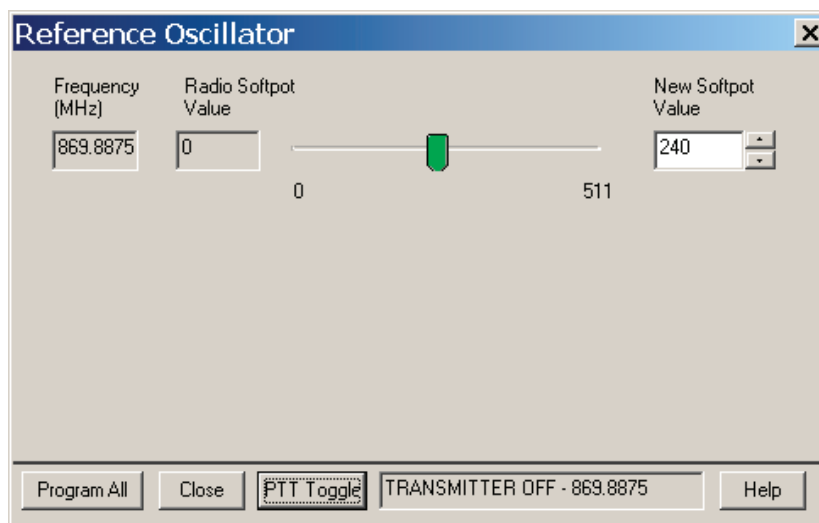


Figure 6-8. Reference Oscillator Window

2. If you are using the R-2670 analyzer, enter the frequency displayed on the Tuner screen in the "RF control" section of the R-2670. Under the "Meter" section of the display, choose RF DISPLAY.
3. Left-click the **PTT Toggle** button on the screen to make the radio transmit. The screen indicates whether the radio is transmitting.
4. Wait five seconds until the analyzer reading stabilizes, and then record the transmitter frequency.
5. Adjust the reference oscillator's softpot value until the measured value is as close as possible to the frequency shown on the screen. Allow approximately five seconds for the analyzer frequency reading to stabilize after each change. See Table 6-10.

Table 6-10. Reference Oscillator Alignment

Band	Target
VHF	±150 Hz
UHF	±150 Hz
800 MHz	±100 Hz

6. Left-click the **Program All** button on the screen to dekey the radio and save the tuned values.
7. Left-click the **Close** button on the screen to return to the Tuner Main Menu.



### 6.4.5 Power Detector Calibration

**NOTE:** This alignment is required after replacing (or servicing) the transceiver board.

The power detector calibration alignment procedure adjusts the buffer gain for the forward power detector to minimize radio power variation from radio to radio.

**NOTE:** Antenna port should be terminated with calibrated power meter through a 30 db RF pad.

1. Set the power supply voltage and current limit as indicated in [Table 6-11](#).

*Table 6-11. Power Supply Voltage Settings*

Band/Power Level	Supply Voltage (V)	Supply Current Limit (A)
VHF 50 W/25 W	13.6	15
VHF 100 W	13.4	25
UHF R1 40 W	13.6	15
UHF R1 100 W	13.4	25
UHF R2 45 W	13.6	15
700–800 MHz 35 W	13.6	15

2. Select **Power Detection Calibration** from the Tuner Main Menu.

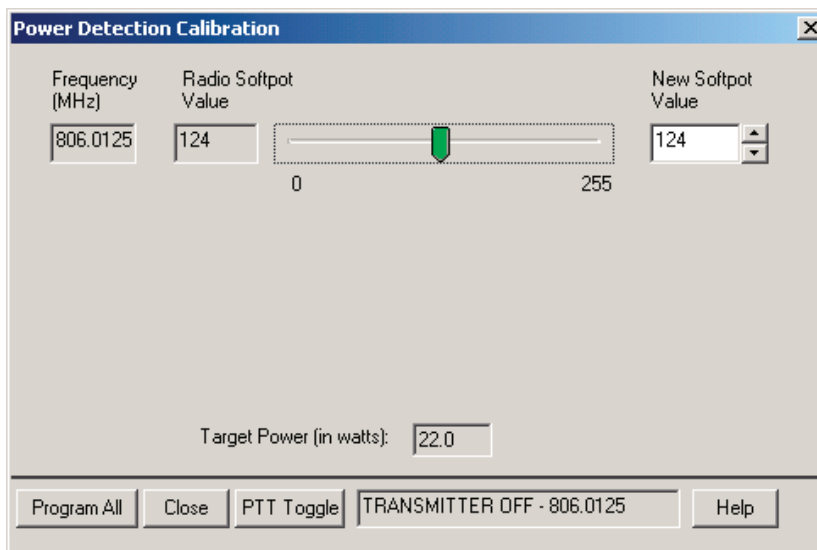


Figure 6-9. Power Detection Calibration Alignment Screen

3. Left-click the **PTT Toggle** button to transmit at indicated frequency.
4. Adjust softpot value until target power is achieved.
5. Left-click the **PTT Toggle** button to disable transmit mode.
6. Left-click the **Program All** button to save tuned value.
7. Left-click **Close** button to close screen and return to the Tuner Main Menu.

#### 6.4.6 Tx Power Characterization

**NOTE:** This alignment is required after replacing (or servicing) the transceiver board.

The Tx Power Characterization alignment procedure characterizes power tuning so that Tx power can be adjusted with CPS software. You will transmit at two power levels for each test frequency and record the measured power level with 0.1 W resolution.

**NOTE:** The antenna port should be terminated with a calibrated power meter through a 30 db RF pad.

1. Set the power supply voltage and current limit as indicated in [Table 6-12](#).

Table 6-12. Power Supply Voltage Settings

Band/Power Level	Supply Voltage (V)	Supply Current Limit (A)
VHF 50 W/25 W	13.6	8
VHF 100 W	13.4	25
UHF R1 40 W	13.6	15
UHF R1 100 W	13.4	25
UHF R2 45 W	13.6	15
700–800 MHz 35 W	13.6	15

2. Select **Tx Power Characterization** from the Tuner Main Menu.

Frequency (MHz)	Measured Power 1 (in watts):	Measured Power 2 (in watts):
762.0125	0	0
769.0125	0	0
775.9875	0	0
794.0125	0	0
805.9875	0	0
806.0125	0	0
823.9875	0	0
851.0125	0	0
860.0125	0	0
869.8875	0	0

Program All Close PTT Toggle TRANSMITTER OFF - 762.0125 Help

Figure 6-10. Tx Power Characterization Alignment Screen

3. Left-click in the first box of the Measured Power 1 column. A green circle will appear to the left of the box indicating active characterization point.
4. Left-click the **PTT Toggle** button to transmit at indicated frequency and record power measurement with 0.1 W resolution. The green circle will turn red, indicating that the radio is transmitting.
5. Left-click the **PTT Toggle** button to disable transmit mode.
6. Enter the power measurement with 0.1 W resolution, overwriting any value that may reside in the box from previous tuning.
7. Left-click in the first box of the Measured Power 2 column. The green circle will move to the left of this box, indicating it has become active characterization point.
8. Repeat steps 4-6.
9. Repeat steps 3-8 for the remaining frequencies.
10. Left-click the **Program All** button to save tuned value.
11. Left-click **Close** button to close screen and return to the Tuner Main Menu.

### 6.4.7 Tx Current Limit

**NOTE:** This alignment is required after replacing (or servicing) the transceiver board or after there has been a change in the CPS-adjustable power level.

The Tx Current Limit alignment procedure tunes the Tx current-limiting protection. If you increase the CPS-adjustable power level, then the current limit must be retuned so the radio can achieve the desired power level. If you decrease the CPS-adjustable power level, the current limit can be retuned to increase protection. You must first determine the test frequency at which maximum transmit current occurs and then tune on that test frequency.

**NOTE:** The antenna port should be terminated with a calibrated power meter through a 30 dB RFpad.

1. Set the power supply voltage and current limit as per [Table 6-13](#).

*Table 6-13. Power Supply Voltage Settings*

Band/Power Level	Supply Voltage (V)	Supply Current Limit (A)
VHF 50 W/25 W	13.6	15
VHF 100 W	13.4	25
UHF R1 40 W	13.6	15
UHF R1 100 W	13.4	25
UHF R2 45 W	13.6	15
700–800 MHz 35 W	13.6	15

2. Select **Tx Current Limit** from the Tuner Main Menu.

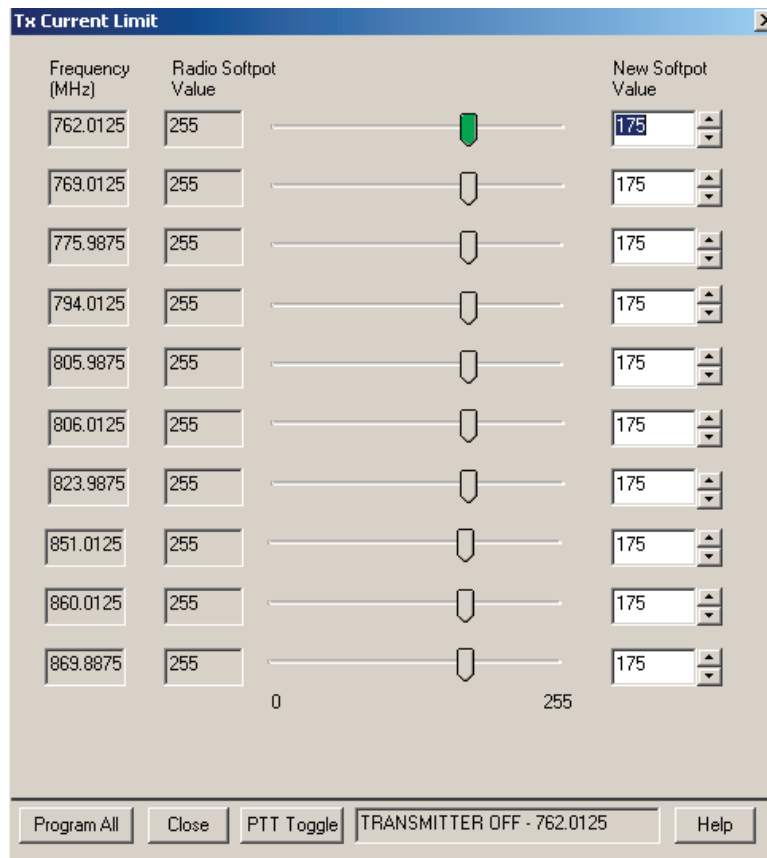


Figure 6-11. Tx Current Limit Alignment Screen

3. Use a slider or the spin buttons to change any one softpot value to 255.
4. Left-click the **Program All** button to save the tuned value. All softpots will change to 255, and transmit-current limiting will be disabled.
5. Left-click in the upper softpot box.
6. Left-click the **PTT Toggle** button to transmit and record radio the transmit current drain. The tuner software uses a high CPS-adjustable power-level setting when transmitting.
7. Left-click the **PTT Toggle** button to disable transmit mode.
8. Repeat steps 6 and 7 for each test frequency to determine the frequency at which maximum transmit current drain occurs.
9. Once the proper test frequency is determined, left-click the **PTT Toggle** button to transmit and record transmit power on that test frequency.
10. Decrease the softpot value until transmit power degrades by 5%, and then left-click the **PTT Toggle** button to disable transmit.
11. Increase the softpot value to set the proper operating head room.

Table 6-14. Transmit Current Limit Offset

Band/Power Level	Current Limit Offset
VHF 50 W/25 W	8
VHF 100 W	18
UHF R1 40 W	5
UHF R1 100 W	20
UHF R2 45 W	14
700–800 MHz 35 W	8

12. Left-click the **Program All** button to save tuned value.

13. Left-click the **Close** button to close screen and return to the Tuner Main Menu.

Table 6-15. Transmit Current Limit Devices

Band/Power Level	Devices		
VHF 50 W/25 W	Final		
VHF 100 W	Final1	Final2	Driver
UHF R1 40 W	Final1	Final2	
UHF R1 100 W	Final1	Final2	Driver
UHF R2 45 W		Final2	
700–800 MHz 35 W	Final1	Final2	Driver

### 6.4.8 Tx Deviation Balance (Compensation)

**NOTE:** This alignment is required after replacing (or servicing) components on the transceiver board.

The Tx Deviation Balance (Compensation) alignment procedure balances the modulation contributions of the low- and high-frequency portions of a baseband signal. Proper alignment is critical to the operation of signaling schemes that have very low frequency components (for example, DPL) and could result in distorted waveforms if improperly adjusted. This procedure needs to be performed at multiple frequencies to allow for proper alignment across the entire RF band. The RF band is divided into frequency zones with a calibration point (value) in each zone. When performing this tuning procedure, the **PTT Tone Low** generates an 80 Hz modulation frequency. The deviation level of this 80 Hz tone is used as the reference level for adjusting the deviation level of the **PTT Tone High**, which is a 3 kHz modulation frequency.

This test can be done with either the R-2670 Communication Analyzer or the Agilent 8901 Modulation Analyzer. The method of choice is the R-2670 Analyzer.

- Initial setup using the R-2670 Communication Analyzer:
  - Connect a BNC cable between the "DEMODO OUT" port and the "VERT/SINAD DIST/DMM COUNTER IN" port on the R-2670.

- Press the SPF key on the R-2670 to display the "SPECIAL FUNCTIONS MENU." Move the cursor to "High Pass," and select 5 Hz on the soft key menu. Select 20 kHz for the "Low Pass" setting.
  - In the "RF Control" section of the R-2670, enter the frequency displayed on the Tuner screen. Move the cursor to the "B/W" setting and select "WIDE  $\pm 100$  kHz" on the soft key menu.
  - Place the R-2670 cursor in the "Display" zone. Select "AC VOLTS" on the soft key menu. Move the cursor to the "Range" setting and select "AUTO."
- Initial setup using the 8901 Modulation Analyzer:
    - Press the FM MEASUREMENT button. (The "Error 03-input level too low" indication is normal until an input signal is applied.)
    - Simultaneously press the Peak - and Peak + buttons. Both LEDs on the buttons should light.
    - Press the 15 kHz LP filter key.
1. Select **TX Deviation Balance (Compensation)** from the Tuner Main Menu. The screen will indicate the transmit frequencies to be used.

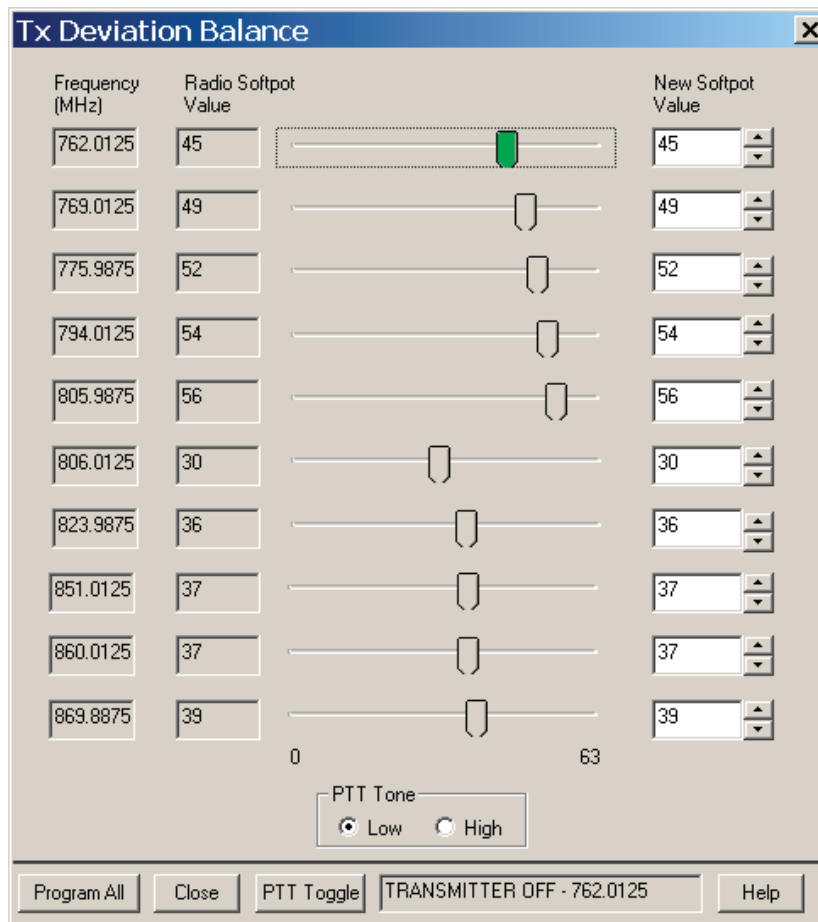


Figure 6-12. Tx Deviation Balance (Compensation) Alignment Screen

2. Left-click the highest frequency field first.
3. Left-click the **PTT Tone Low** button.

4. Left-click the **PTT Toggle** button on the screen to enable transmission. The screen indicates whether the radio is transmitting. Wait approximately 5 seconds until the voltage shown on R-2670, or the deviation shown on the 8901 Analyzer, stabilizes.
5. Measure and record the AC voltage value from the R-2670 Analyzer or the deviation value from the 8901 Analyzer.
6. Left-click the **PTT Tone High** button.
7. Adjust the softpot value until the measured deviation/voltage, when using the high tone, is within  $\pm 1.5\%$  of the value observed when using the low tone.
8. Repeat steps 3-7 for the remaining frequencies.
9. Left-click the **Program All** button on the screen to dekey the radio and save the tuned values.
10. Left-click the **Close** button on the screen to return to the Tuner Main Menu.

### 6.4.9 Tx Deviation Limit

**NOTE:** This alignment is required after replacing (or servicing) components on the transceiver board.

The Tx Deviation Limit alignment procedure limits the modulation of a baseband signal. It is used for primary modulation limiting. This procedure needs to be performed at multiple frequencies to allow for proper alignment across the entire RF band. The RF band is divided into frequency zones with a calibration point (value) in each zone.

This test can be done with either the R-2670 Communication Analyzer or the Agilent 8901 Modulation Analyzer. The method of choice is the R-2670 Analyzer.

- Initial setup using the R-2670 Communication Analyzer:
    - Connect a BNC cable between the "DEMOD OUT" port and the "VERT/SINAD DIST/DMM COUNTER IN" port on the R-2670.
    - Press the SPF key on the R-2670 to display the "SPECIAL FUNCTIONS MENU." Move the cursor to "High Pass," and select 5 Hz on the soft key menu. Select 20 kHz for the "Low Pass" setting.
    - In the "RF Control" section of the R-2670, enter the frequency displayed on the tuner screen. Move the cursor to the "B/W" setting and select "WIDE  $\pm 100$  kHz" on the soft key menu.
    - Place the R-2670 cursor in the "Display" zone. Select "AC VOLTS" on the soft key menu.
    - Move the cursor to the "Range" setting and select "AUTO."
  - Initial setup using the 8901 Modulation Analyzer:
    - Press the FM MEASUREMENT button. (The "Error 03-input level too low" indication is normal until an input signal is applied.)
    - Simultaneously press the Peak - and Peak + buttons. Both LEDs on the buttons should light.
    - Press the 15 kHz LP filter key.
1. Select **TX Deviation Limit** from the Tuner Main Menu. The screen will indicate the transmit frequencies to be used. See [Figure 6-13 on page 6-18](#).



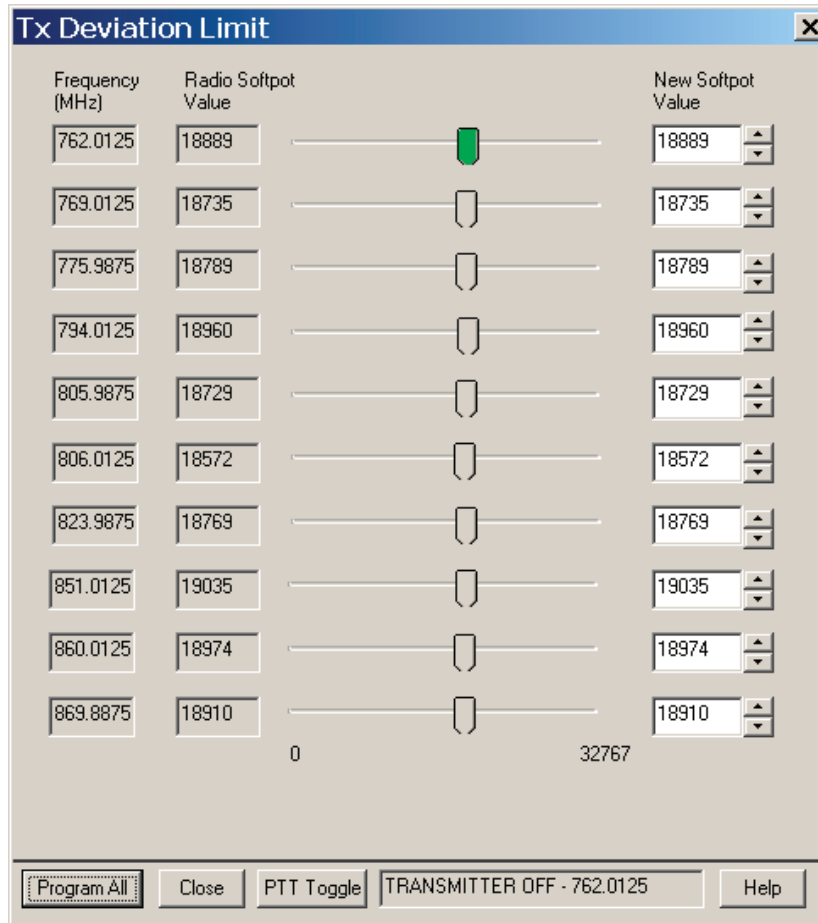


Figure 6-13. Tx Deviation Limit Alignment Screen

- Left-click the highest frequency field first.
- Left-click the **PTT Toggle** button on the screen to make the radio transmit. Wait approximately 5 seconds until the deviation/voltage displayed on the analyzer stabilizes. The screen indicates whether the radio is transmitting.
- Adjust the deviation limit between 0.158 and 0.163 Vac on the R-2670 (2.785 to 2.885 kHz). The optimum setting is 0.160 Vac (2.83 kHz).
- Repeat steps 3-5 for the remaining frequencies.
- Left-click the **Program All** button on the screen to dekey the radio and save the tuned values.
- Left-click the **Close** button on the screen to return to the Tuner Main Menu.

#### 6.4.10 Receive Front-End Filter (UHF Only)

**NOTE:** The receiver front-end filter alignment is available only for the UHF band of the XTL 5000 radio. This alignment is required after replacing or servicing the RF board.

This alignment procedure adjusts the receiver front-end bandpass filters for the best receiver sensitivity and selectivity. It should be performed for all test frequencies to allow for proper software interpolation for frequencies between the test frequencies in the band.

- Apply an RF signal with no modulation at -90 dBm on the current operating frequency.

2. To find the RSSI Peak:
  - a. Start with a softpot value of at least 10, and adjust the softpot value either by clicking the up arrow and incrementing the **New Softpot Value** spin box or by directly entering the desired value into the **New Softpot Value** spin box.

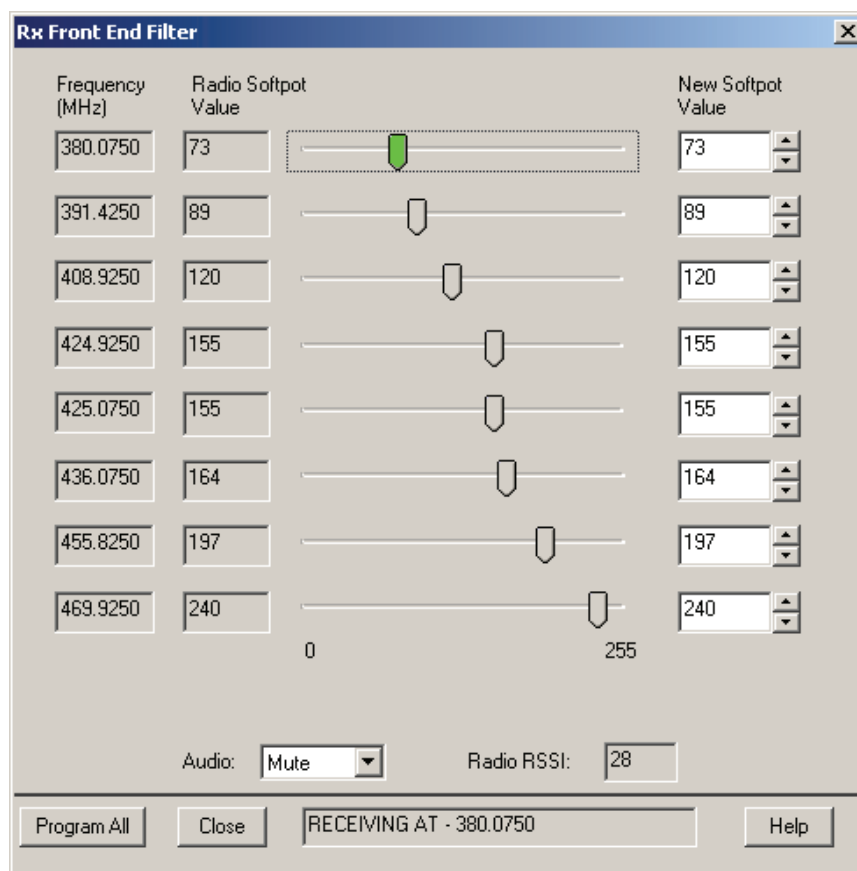


Figure 6-14. Rx Front-End Filter Alignment Screen

- b. Increase the softpot value and note the radio RSSI values until the **Radio RSSI** value = Peak. The RSSI will reach a peak value, remain stable, and then start decreasing.
  - c. Record the softpot value.
3. To find the lowest softpot value in the peak range:
  - a. Lower the softpot value until the **Radio RSSI** value = RSSI Peak -2. For example, if the peak RSSI value = 83, then  $83-2=81$ .
  - b. Record the softpot value.
4. To find the highest softpot value in the peak range:
  - a. Increase the softpot value and continue past the RSSI peak until the **Radio RSSI** value = RSSI Peak -2.
  - b. Record the softpot value. If this point (RSSI value = peak -2) cannot be found, use the highest softpot value as the value for this step.
5. Calculate the middle of the lowest and highest softpot values defined above, and then enter this value in the **New Softpot Value** spin box and click the **Program All** box.

6. Repeat steps 1 through 5 for all the remaining tuning frequencies.
7. Click the **Program All** button to save the tuned values in the radio.

## 6.5 Performance Testing

### 6.5.1 Bit Error Rate (BER) Test

This procedure tests the Bit Error Rate (BER) of the radio's receiver at a desired frequency and contains the fields described in [Table 6-16](#).

Figure 6-15. Bit Error Rate Screen

Table 6-16. Bit Error Rate Test Fields

Field	Description
Rx Frequency	Selects the Receive Frequency in MHz.
Test Pattern	Selects the Digital test pattern - TIA. Choices are: <b>Standard Tone Test Pattern</b> (framed 1011) and <b>Standard Interface Test Pattern</b> (CCITT V.52).
Modulation Type	Selects the digital modulation type of the incoming signal on which BER is to be calculated.
Continuous Operation	<p>Allows the user to adjust the number of test repetitions. A selection of <b>Yes</b> will cause the radio to calculate BER on a continuous basis indefinitely and update the results on this screen after each integration time. A selection of <b>No</b> will cause the BER test to execute only one sample and then update the display.</p> <p><b>NOTE:</b> When Continuous Operation = Yes, all fields will be dimmed while the test is in progress. They will be enabled when the test is complete, or if the STOP button is pressed.</p> <p>When Continuous Operation = No, a wait cursor will be displayed while the test is in progress and return to normal when the test is done.</p>

Table 6-16. Bit Error Rate Test Fields (Continued)

Field	Description
Audio	Allows the user to select the audio output during a test. Selecting <b>External</b> will route the same signal to the radio's accessory connector audio output. Selecting <b>Internal</b> is not supported. Selecting <b>Mute</b> will disable the audio output.
BER Integration Time	Represents the amount of time during which the Bit Error Rate is to be calculated. Remember that integration over a longer time period results in a more precise measurement, at the expense of more time per measurement.  <b>NOTE:</b> This is especially useful in fading measurements.  The range is from 0.360 to 91.8 seconds in increments of 0.360 seconds.

## 6.5.2 Transmitter Test Pattern

This procedure allows you to generate test patterns at selectable frequencies and channel spacing to check the transmitter. The procedure contains the fields described in [Table 6-17](#).

Table 6-17. Transmitter Test Pattern Fields

Field	Description
Tx Frequency	This field selects the Transmit Frequency directly in MHz.
Channel Spacing	This field allows the user to select the desired transmit deviation in kHz.
Test Pattern Type	This field represents the type of test pattern which will be transmitted by the radio when the PTT Toggle button is pressed.

**NOTE:** Channel Spacing and Test Pattern Type fields will be dimmed while the radio is transmitting.

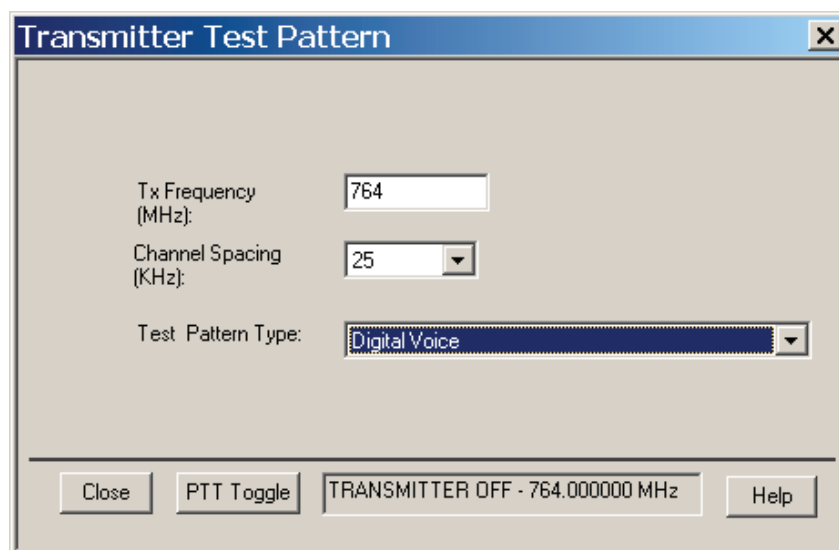


Figure 6-16. Transmitter Test Pattern Screen

## Notes

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## Chapter 7 Encryption

### 7.1 Universal Crypto Module Kits

**NOTE:** This information applies to both conventional and trunked systems.

The encryption modules use a custom encryption IC and an encryption key variable to perform their encode/decode functions. The encryption key variable is loaded into the encryption module using a key variable loader (KVL). The encryption IC corresponds to the particular encryption algorithm purchased.

[Table 7-1](#) contains the Universal Crypto Module (UCM) kits and their corresponding algorithms for secure-equipped XTL 5000 radios.

*Table 7-1. UCM Kit Listing*

Kit Number	Description
NNTN4006_	DES, DES-XL, DES-OFB ENCRYPTION KIT-UCM
NTN9837_	DES, DES-XL, DES-OFB WITH DVP-XL ENCRYPTION KIT-UCM
NTN9838_	DVI-XL ENCRYPTION KIT-UCM
NTN9839_	DVP-XL ENCRYPTION KIT-UCM
NNTN4941_	DES, DES-XL, DES-OFB ENCRYPTION KIT-UCM
NNTN4938_	DVI-XL ENCRYPTION KIT-UCM
NNTN4940_	DVP-XL ENCRYPTION KIT-UCM
NNTN4939_	DES, DES-XL, DES-OFB WITH DVP-XL ENCRYPTION KIT-UCM
NNTN4935_	AES ENCRYPTION KIT-UCM
NNTN4936_	AES with DES, DES-XL, DES-OFB ENCRYPTION KIT-UCM
NNTN4937	ADP ENCRYPTION KIT-UCM
NNTN4932_	ADP with AES ENCRYPTION KIT-UCM
NNTN4933_	ADP with DES, DES-XL, DES-OFB ENCRYPTION KIT-UCM
NNTN4934_	ADP with AES, DES, DES-XL, DES-OFB ENCRYPTION KIT-UCM

### 7.1.1 Secure Interface Boards

Table 7-2 contains the secure interface board kits, which are used in conjunction with the UCM kits. Every secure-equipped radio must contain one of the two secure interface board kits, which is paired with one of the UCM kits.

Table 7-2. Secure Interface Board Kits

Kit Number	Description
MHLN6918_	Secure Interface Board, 3-day key retention
MHLN6919_	Secure Interface Board, 30-second key retention

### 7.1.2 Secure Dispatch Operation

For personalities or talkgroups that are programmed to be secure-selectable, press and release the *Secure* button to toggle between Secure and Clear.

- An illuminated secure status annunciator indicates that the transmitted signal will be encrypted when the **PTT** button is pressed.
- The absence of the secure status annunciator indicates that the transmitted signal will not be encrypted.

Whether the current personality is strapped for secure or clear, the secure status annunciator correctly displays the transmit operation as being either secure (encrypted) or clear (non-encrypted).

**NOTE:** You cannot change from secure to clear while the **PTT** button is pressed. The radio will generate an illegal tone and the transmission will be terminated.

Secure-equipped radios automatically determine whether a secure or clear voice message is being received. This allows you to receive either type of message without having to reset the programmable secure button.

### 7.1.3 Secure Emergency Operation

Clear or Secure emergency-call operation is determined by the programming of the selected mode (or talkgroup) or the default emergency mode, if set up. Otherwise, transmit operation is controlled by the setting of the secure, programmable button. You will not be able to change from Secure to Clear, or from Clear to Secure, operation during an emergency call.

## 7.2 Load an Encryption Key

To load an encryption key into an XTL 5000 radio:

1. Ensure that an encryption module is installed in the radio.
2. Ensure the secure shield is installed and screwed into chassis prior to radio power-up. This is necessary for proper radio operation.
3. Load an encryption key into the radio's memory from a key-variable loader (KVL) using the correct loader for the radio's encryption type.

Attach the keyloader cable to the control head GCAI connector in the dash mount configuration and to the TIB GCAI connector in the remote mount configuration.

4. KEYLOADING is displayed on the radio display while the key transfer is in progress.

For single-key radios, a short tone sounds when a key is successfully loaded.

For multi-key radios, an alternating tone sounds for a few seconds after keys are successfully loaded.

**NOTE:** An invalid encryption key aborts a secure transmission. KEYFAIL is displayed and a keyfail tone (consecutive medium-pitched beeps) sounds until you release the PTT button.

5. If a mode is not programmed for either secure or clear-only operation, use the secure programmable button to select secure or clear transmission.

**NOTE:** You cannot change from secure to clear, or from clear to secure, while pressing the PTT button.

## 7.3 Advanced Secure Operation

**NOTE:** The Advanced Secure feature is available only on radios that have been equipped by the factory to support it. The radio must also be equipped with an encryption module.

Advanced Secure incorporates the Multikey feature and a dual-encryption feature into the existing secure system. Multikey allows a radio to be equipped with multiple encryption keys. A default key is included and is associated with the current mode. The keys are strapped to a given mode or are operator-selectable and can be indexed into groups of keys called keysets. The keys are loaded using a manual keyloader.

In addition, your radio can support up to eight different encryption algorithms simultaneously.

### 7.3.1 Multikey Operation

The multikey feature can be used in both conventional and trunked applications.

- **Conventional Multikey** - The encryption keys can be selectively strapped, one per each channel. In addition, the programmable radio features include operator-selectable keys, operator-selectable indices, and operator-selectable key erasure. Encryption keys are loaded into the radio through a KVL.
- **Trunked Multikey** - If the radio is used for both conventional and trunked applications, the encryption keys have to be strapped for trunking on a talkgroup, or announcement group, basis. In addition, a different encryption key can be strapped to other features, such as Private Call, Dynamic Regrouping, Failsoft, Interconnect, System Wide, or Emergency Talkgroup.



## 7.4 Erase a Single Key

1. Press the menu button labeled `ERAS`. Alternatively, press and hold the menu button labeled `SEC` until a tone sounds. Then press `ERAS` on the second menu that is displayed. If `ERAS` or `SEC` is not on the current menu, use the NAV key to scroll through the available menus.

The last selected key is displayed.

2. Use the NAV key to scroll through the encryption keys until the key to be erased is displayed. Alternatively, if a keypad microphone is used, press the numeric keys to jump to the desired encryption key.

`ERASED` alternates with the key name if the displayed key is blank.

3. Press the menu button labeled `SNGL` to erase the selected key.

`ERASE SNGL KEY` followed by the key name is displayed.

4. Press the menu button labeled `YES`.

The selected key is set to zero.

`ERASED` is alternately displayed with the key name confirming the erasure.

5. To exit the menu without erasing a key, press the menu button labeled `ABRT`, the PTT button, or the home button.

## 7.5 Erase All Keys

1. Press the menu button labeled `ERAS`. Alternatively, press and hold the menu button labeled `SEC` until a tone sounds. Then press `ERAS` on the second menu that is displayed. If `ERAS` or `SEC` is not on the current menu, use the NAV key to scroll through the available menus.

The last selected key is displayed.

2. Press the menu button labeled `ALL`.

`ERASE ALL KEYS` is displayed.

3. Press the menu button labeled `YES`. All keys are erased.

`ERASED` is alternately displayed with the displayed key name confirming the erasure.

4. To exit the menu without erasing the keys, press the menu button labeled `ABRT`, the PTT button, or the home button.

## 7.6 Over-the-Air Rekeying

The over-the-air rekeying (OTAR) feature allows the dispatcher to reprogram the encryption keys in the radio remotely. The following steps describe how to use this feature.

1. Press the menu button labeled **REKY**. Alternatively, press and hold the menu button labeled **SEC** until a tone sounds. Then press **REKY** on the second menu that is displayed. If **REKY** or **SEC** is not on the current menu, use the **NAV** key to scroll through the available menus.

**REQUEST REKEY** is displayed.

2. Press the **PTT** button to send the rekey request.

**PLEASE WAIT** is displayed.

One of the following occurs:

The radio sounds five tones when the dispatcher has received the request.

**NOTE:** Any subsequent press of the **PTT** button will exit the OTAR feature and allow you to transmit in the normal manner. Pressing the **HOME** or emergency button also exits the feature.

If the display momentarily shows **REKEY FAIL** and the bad-key tone sounds, then the rekey operation failed because the radio does not contain the Unique Shadow Key (USK) or Unique Key Encryption Key (UKEK). You have to load the USK into the radio using the KVL before the radio can be reprogrammed over the air.

**NOTE:** If you exit at this point, but stay on the current channel in the dispatch mode, the radio momentarily shows **REKEYED** or **DENIED** and sounds a tone indicating the status of the rekey request.

If the display shows **NO ACK** and the bad-key tone sounds, then the dispatcher has not acknowledged your request after the radio has tried five times to send it. The radio then returns to the display message in step 1, allowing you to retry the request.

If the request is accepted and the radio is successfully rekeyed, the display momentarily shows **REKEYED**.

If the display momentarily shows **DENIED** and the bad-key tone sounds, the request has been denied by the dispatcher, and the radio returns to the home display.


## **Notes**

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## Chapter 8 Disassembly/Reassembly Procedures

### 8.1 Introduction

This section details the procedures necessary to remove and replace the printed circuit board in the ASTRO XTL 5000 radio. After troubleshooting and determining what needs to be replaced, disconnect the test equipment, the antenna cable, and the power cable.

 WARNING	<b>Disconnect the power cable from the radio before opening and removing the PCB. Failure to remove power can result in unit damage caused by transients or accidental shorts, as well as presenting a shock hazard.</b>
----------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Locate the exploded view of the radio in [Chapter 11. Exploded Views and Parts Lists](#). Keep it handy for reference as you disassemble and reassemble the radio.

When installing a new circuit board, all mounting screws should be started before any are torqued. This will help ensure proper alignment.

After installing a new board, perform a complete alignment procedure as outlined in [Chapter 6. Radio Alignment Procedures](#).

### 8.2 Replacement Procedures

After performing alignment procedures, always exit the SERVICE menu entirely (to the MAIN MENU) to properly save all changes. Failure to do so can result in an alignment or other failure.

#### 8.2.1 Required Tools and Supplies

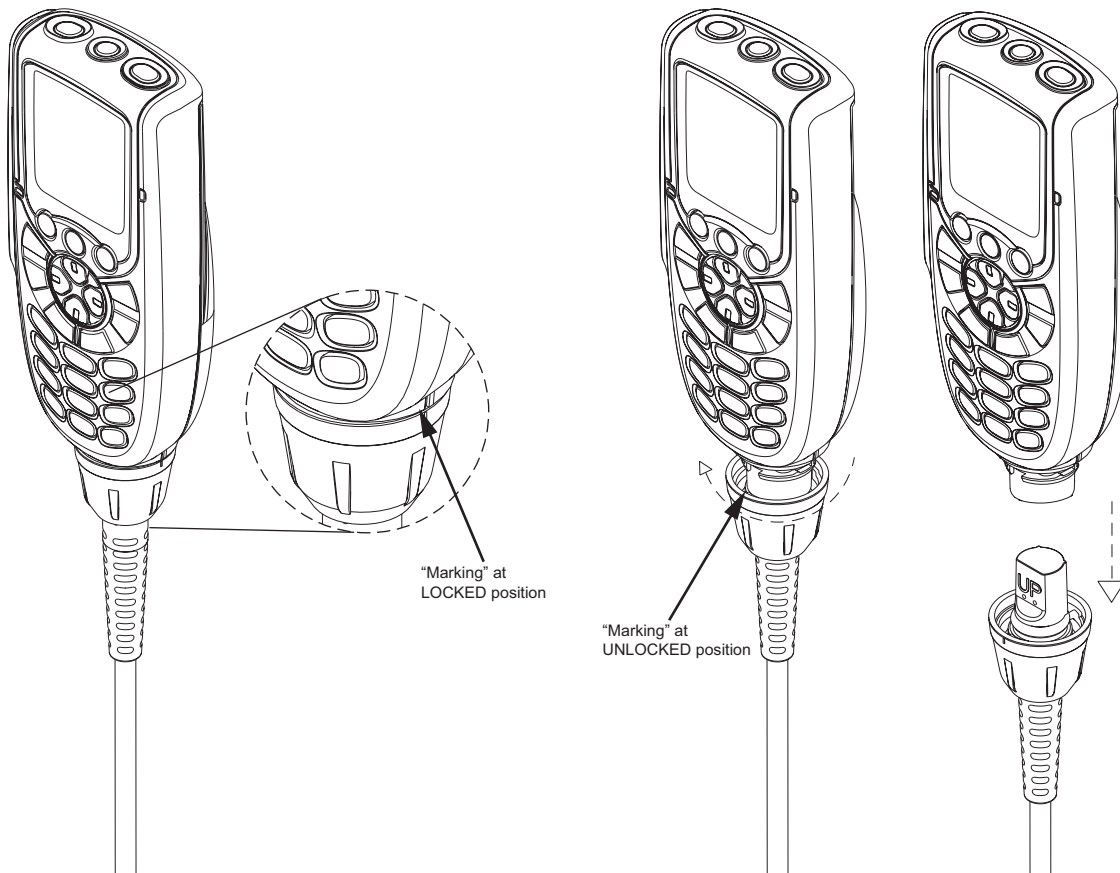
*Table 8-1. Required Tools and Supplies*

Tools and Supplies	Motorola Part Number
Anti-static grounding kit	0180386A82
Chassis eliminator (Mid Power)	8180384N71
Chassis eliminator (High Power)	8180384S04
Dismantling tool	6686119B01
Electromagnetic Interference (EMI) metallic shielding tape, or equivalent	1185984D01
Flat-blade screwdriver	
Magnetic screwdriver set with bits	0180320B16
Mini-UHF to N-type adapter cable	3085651A01
Plastic scraping tool	6686119B01
Removal and insertion tool	6680163F01
Roto-Torq adjustable driver	RSX4043
Small, flat-blade screwdriver	
Solder aid (black stick), Hexacon Electric Co.	MA-800G
Torx T10 and T20 bits	

### 8.2.2 XTL 5000 O3 Control Head Disassembly

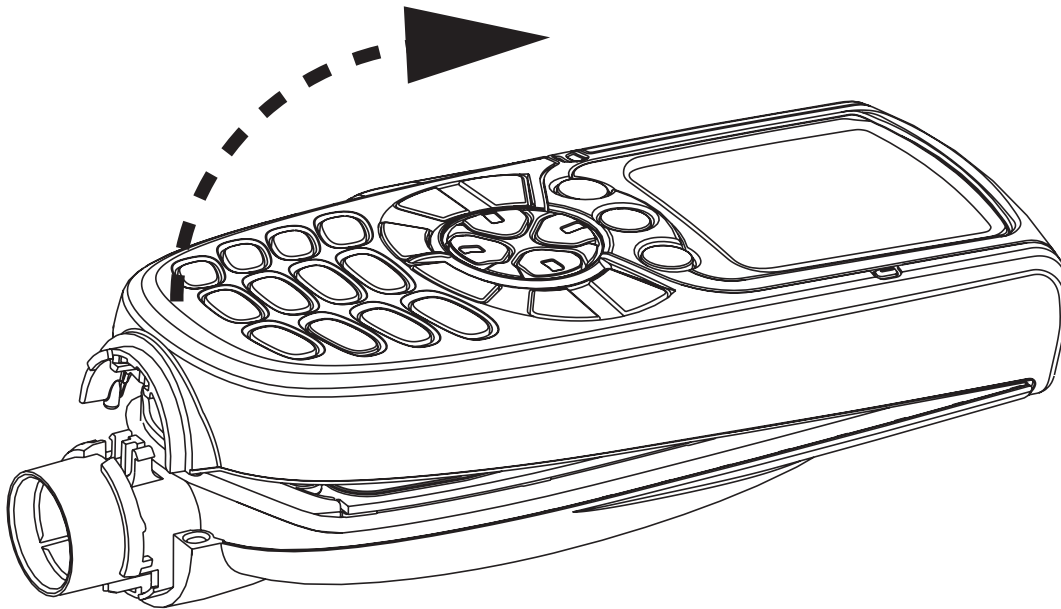
**NOTE:** Bracketed numbers are identical to item numbers shown in [Figure 11-1. "XTL 5000 O3 Control Head Exploded View" on page 11-2.](#)

1. Hold the control head straight up, and twist the cable lock as shown in the figure.



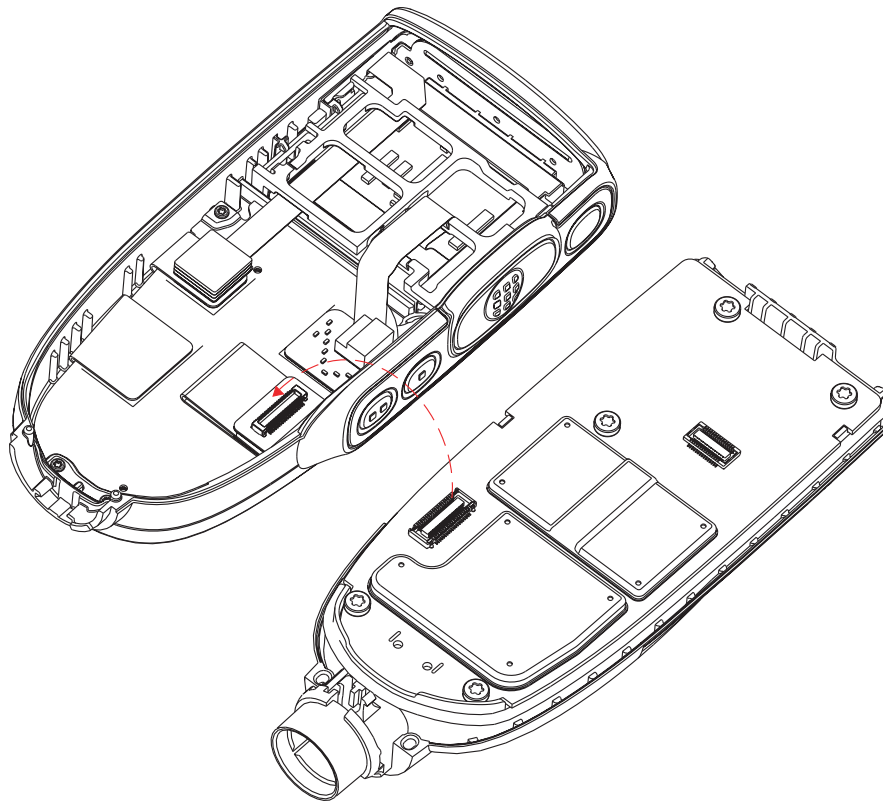
*Figure 8-1. Cable Lock Detachment*

2. While holding the front housing, slowly pull the back housing from the cable insertion hole on the bottom until the 2 housings detached.



*Figure 8-2. Front Housing and Back Housing Detachment*

3. Disconnect the 40-pin connector and separate the front housing.



*Figure 8-3. Separate Front Housing and Back Housing*

4. Using a Torx T-8 screwdriver, remove the 5 printed circuit board (PCB) screws.

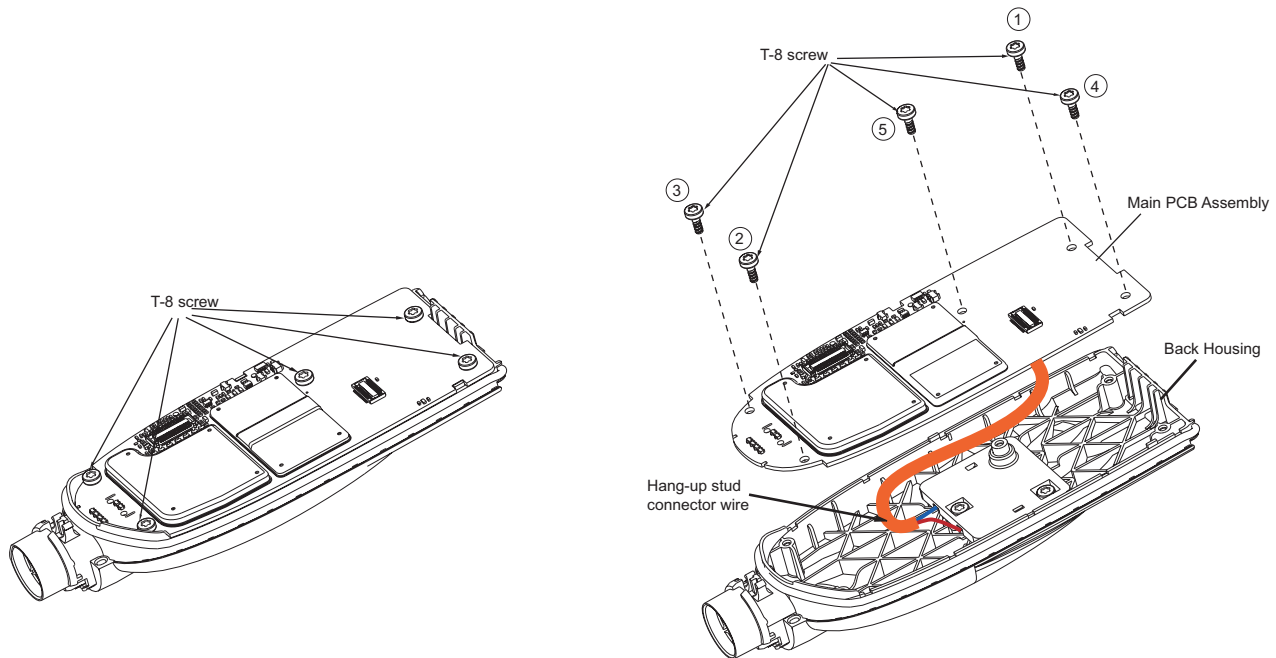


Figure 8-4. PCB Detachment

5. Gently pull out the 2-pin connector which connect the back housing to the PCB.

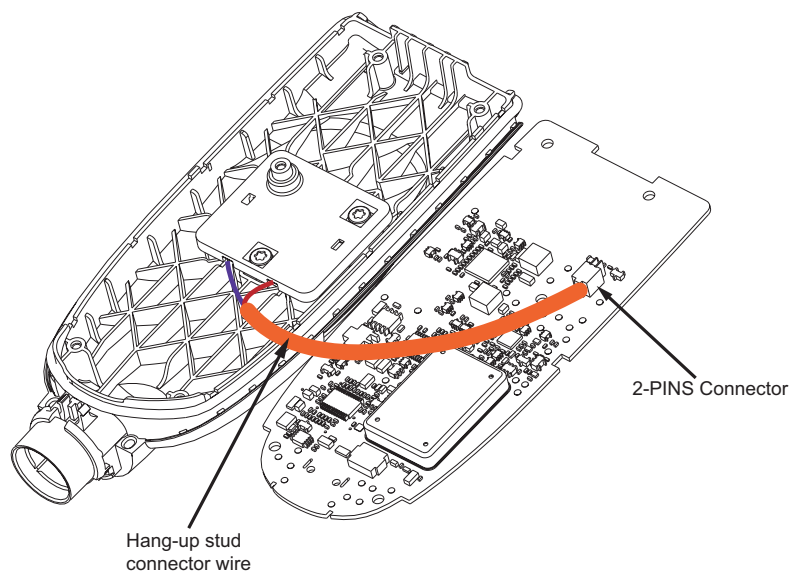


Figure 8-5. Disconnecting the 2-pin Connector

### 8.2.3 XTL 5000 O3 Control Head Reassembly

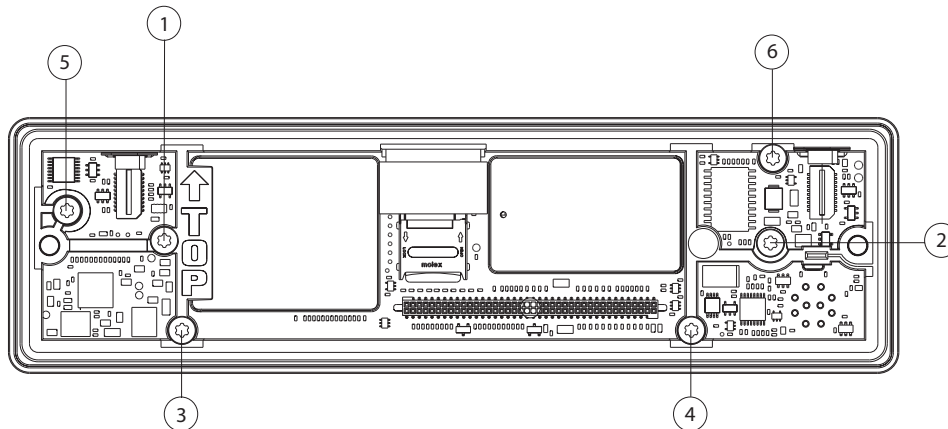
**NOTE:** Bracketed numbers are identical to item numbers shown in [Figure 11-1. “XTL 5000 O3 Control Head Exploded View”](#) on page 11-2.

1. To reassemble, ensure that the wire from the back housing is connected to the PCB and the o-ring seal is installed properly.
2. Place the PCB on the back housing as shown in the picture.
3. Using a Torx T-8 screwdriver, fasten the 5 PCB screws following the sequence as shown in [Figure 8-4](#) (torqued to 4 in. lbs).
4. Plug in the 40-pin connector from Front Housing to the PCB. Make sure the connector is intact.
5. Put the Back Housing and Front Housing together.
6. Insert the coiled cable. Twist the cable lock to tighten the control head.

### 8.2.4 XTL 5000 O5 Control Head Disassembly

**NOTE:** Bracketed numbers are identical to item numbers shown in [Figure 11-2. “XTL 5000 O5 Control Head Exploded View”](#) on page 11-3.

1. Lay the control head face down on a clean, flat surface being careful not to scratch or mar the display.
2. Using a Torx T10 screwdriver, remove the 6 control head screws [15] as shown in [Figure 8-6](#).



*Figure 8-6. Control Head Screw Sequence*

3. Carefully separate the sealframe [14] from the front housing assembly [7].
4. Carefully disconnect the LCD module [11], volume flex assembly [8], and mode switch flex [18].
5. After all the connectors have been unplugged, gently lift up the control head board [13] from the front housing assembly [7].

**NOTE:** Be careful not to damage the LCD module, volume, and mode switch flex connector while lifting the control head board.

### 8.2.5 XTL 5000 O5 Control Head Reassembly

**NOTE:** Bracketed numbers are identical to item numbers shown in [Figure 11-2. “XTL 5000 O5 Control Head Exploded View”](#) on page 11-3.



1. To reassemble, ensure that all the keypads are fully seated into the front housing, and that all the flexes (LCD Display module, volume and mode) will not be covered by the PCB. Ensure that the GCAI seal is properly placed on the GCAI connector.
2. Place the PCB in the housing seating the PCB surface to the screw bosses. Ensure that the aligning boss protrudes through the PCB. See [Figure 8-7](#).

**NOTE:** Be careful not to pinch the flex for the LCD module and the volume switch flex assembly while pushing the board in place.

3. Plug in the three flexes.
4. Place the sealframe onto the PCB locating the “Top” is oriented correctly.
5. Using a Torx T10 screwdriver, fasten the 6 control head screws [15] following the sequence as shown in [Figure 8-6](#) (torqued to 8 in. lbs).

## **8.2.6 Transceiver Interface Board Disassembly/Reassembly**

### **8.2.6.1 Mid Power Model Disassembly**

1. Remove the two front panel TIB mounting screws using a Torx T10 screwdriver.
2. Grasp the front panel firmly, and pry off carefully using similar method as shown in [Figure 8-25](#). Unplug the flex from the radio side, then unplug the flex from the TUC side.
3. Remove the six screws that hold the remote interconnect board to the front panel using a Torx T10 driver.

### **8.2.6.2 High Power Model Disassembly**

1. To remove the front panel from the front of the radio, follow the disassembly procedure outlined in [section 8.2.7.2: High Power Models on page 8-18](#), steps 1-6.
2. Place the front panel face down on a flat surface and remove the six interconnect board retaining screws with a T10 Torx driver.

3. Remove the TUC seal from the connector on the front side of the board and discard.

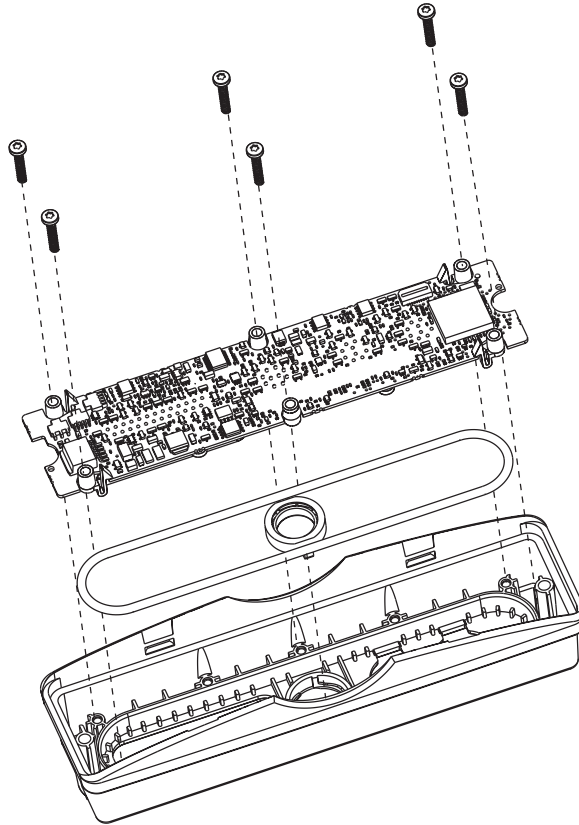


Figure 8-7. Front Panel Disassembly

### 8.2.6.3 Mid Power Model Reassembly

1. Install the TUC seal ensuring it is seated properly to the TUC connector then install the remote interconnect board onto the front panel, and replace the screws. Torque the screws to 6-8 in.-lbs.
2. Ensure that the front seal is properly seated to the radio.



Never attach or remove a flex with power supplied to the radio. Also, take care to avoid misalignment of Flex connector pins upon re-attachment. Failure to remove power or align properly can result in electrical shorting of the circuit board and possible component damage.

3. Reconnect the interconnect flex to the TUC PCB then connect the flex to the radio, noting proper alignment of the mating connections.
4. Reassemble the front panel TUC assembly into the radio and replace the screws.
5. Torque the screws to 6-8 inch-lbs. Over-torque of the screws can result in warping of the circuit board and possible board damage.

### 8.2.6.4 High Power Model Reassembly

1. Place a new, lubricated TUC seal around the perimeter of the connector on the front side of the board ensuring that the center seal encircles the CGAI area.

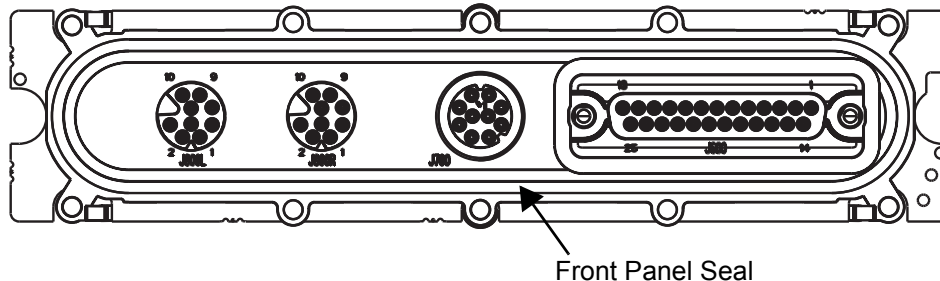
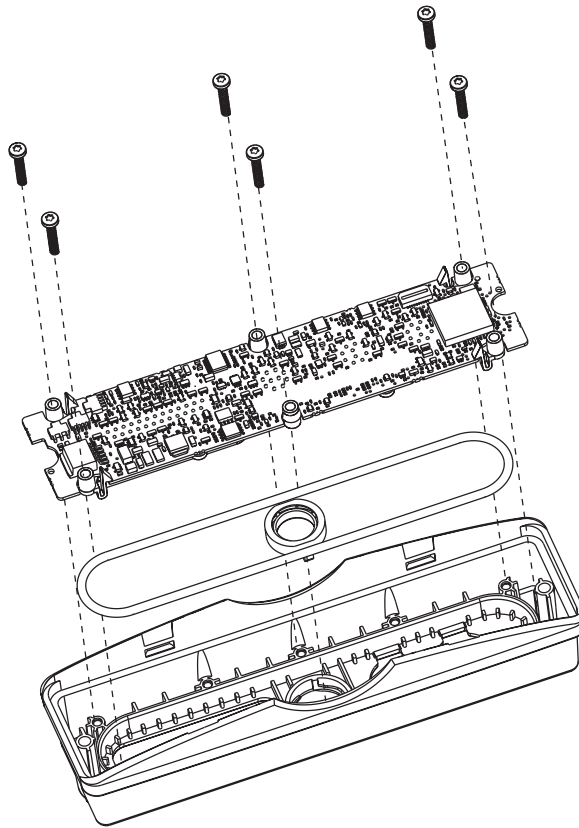


Figure 8-8. TUC Seal Placement

2. Place the interconnect board into the remote front housing with the keying rib of the housing aligned with the slot on the board. If the board will not seat properly in the housing, it may need to be rotated 180° and reinserted.
3. Secure the interconnect board to the housing using six T10 Torx screws torqued to 6-8 in.-lbs each.

4. To reattach the front panel to the front of the radio, follow the reassembly procedure outlined in [section 8.2.8.2: High Power Models](#), [page 8-39](#), steps 9-13.



*Figure 8-9. Front Panel Reassembly*

## **8.2.7 Radio Disassembly**

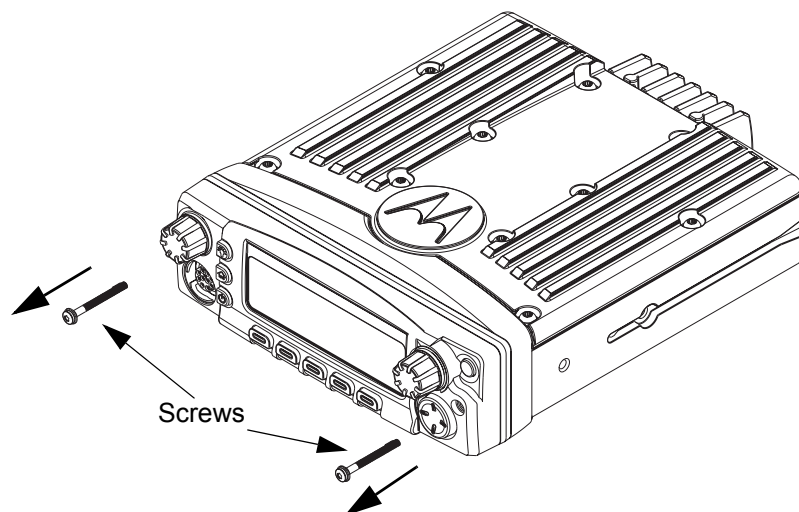
### **8.2.7.1 Mid Power Models**

Use the following procedure to disassemble your radio:

1. Ensure all accessory connections, power, antenna, and microphone are unplugged.

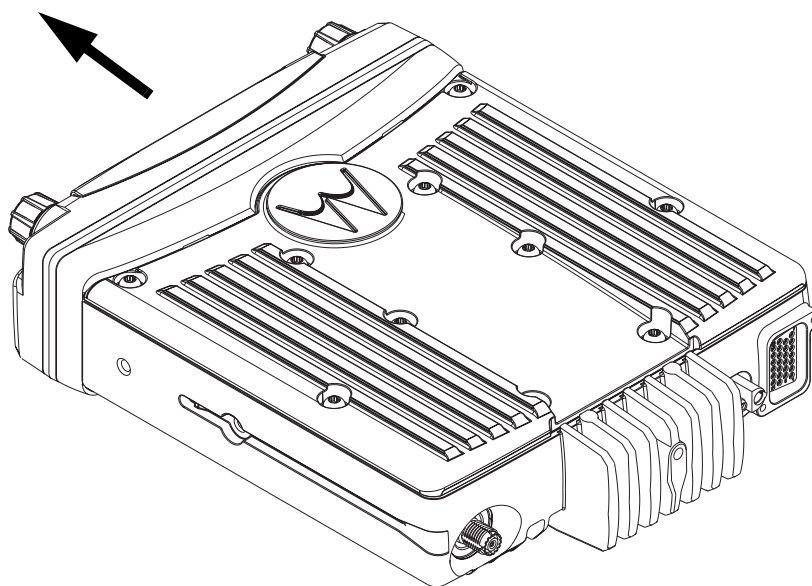
If the radio is a remote-mount radio, disconnect the remote-mount control cable from the front of the transceiver.

2. Remove the two front control head screws using a T-10. Save them for later use.



*Figure 8-10. Removing the Control Head Screws*

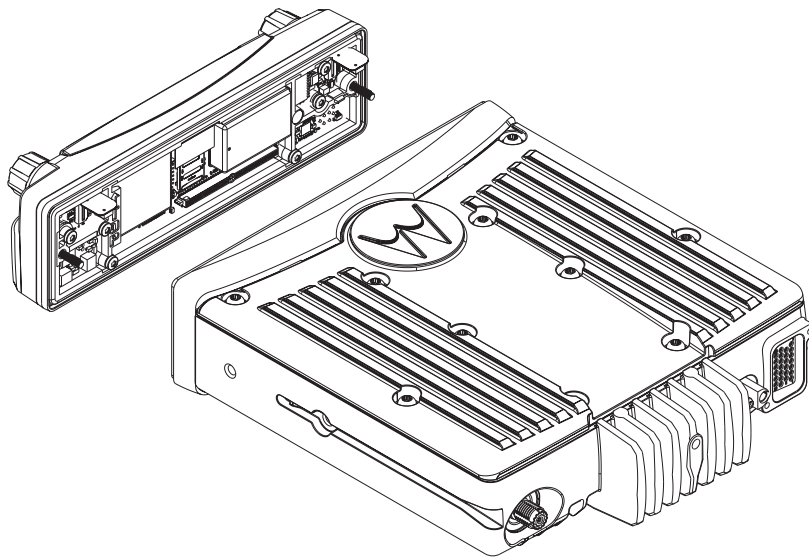
3. Firmly grasp the front panel of the control head or the Transceiver Interface Board (TIB) for remote mount, and carefully remove the control head assembly from the headbridge. Be careful not to pull on the attached flex.



*Figure 8-11. Removing the Control Head*

4. Lay the control head or TIB face down on a clean, flat surface, being careful not to scratch or mar the face of the display.

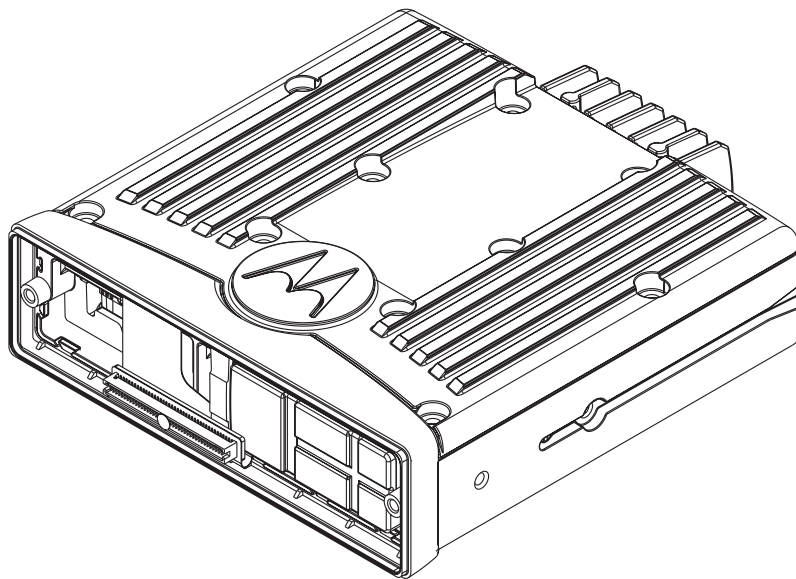
5. Carefully disconnect the control head flex from the control head or TIB and set the control head or TIB aside.



*Figure 8-12. Removing the Flex (Control Head Connector)*

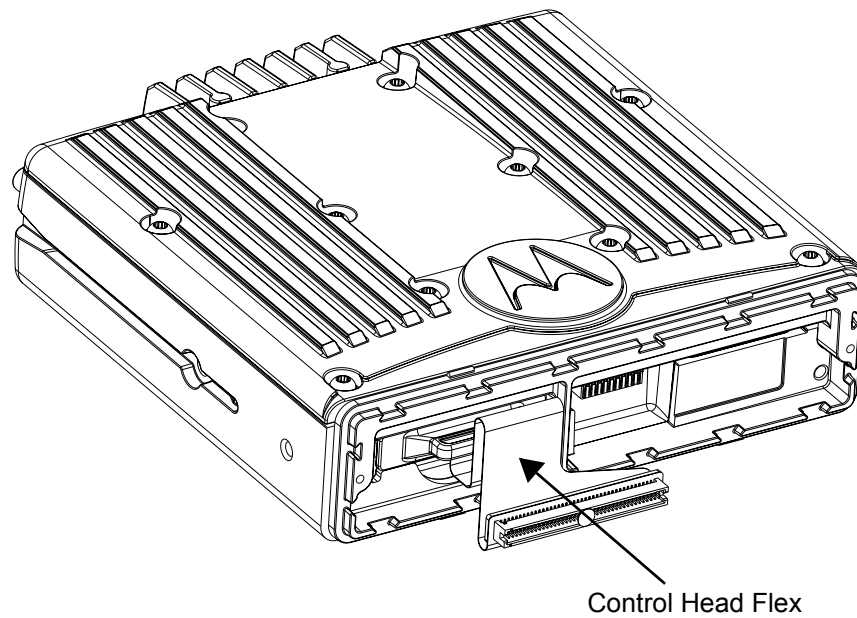
6. Remove the plastic headbridge by squeezing in the center of the top and bottom sides of the part and pulling away from the transceiver.

**NOTE:** Be careful to avoid pulling on the flex



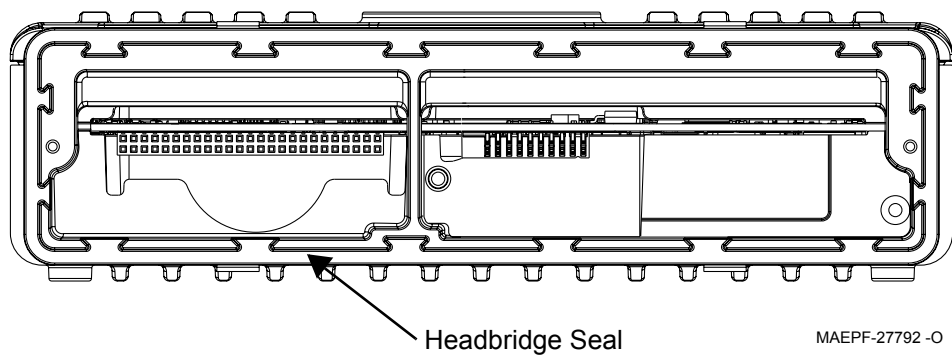
*Figure 8-13. Removing the Headbridge*

7. Carefully remove the control head flex from the transceiver by grasping the provided handle and separating it from the connector.



*Figure 8-14. Removing the Flex (Main-Board Connector)*

8. Remove the headbridge seal from the transceiver.

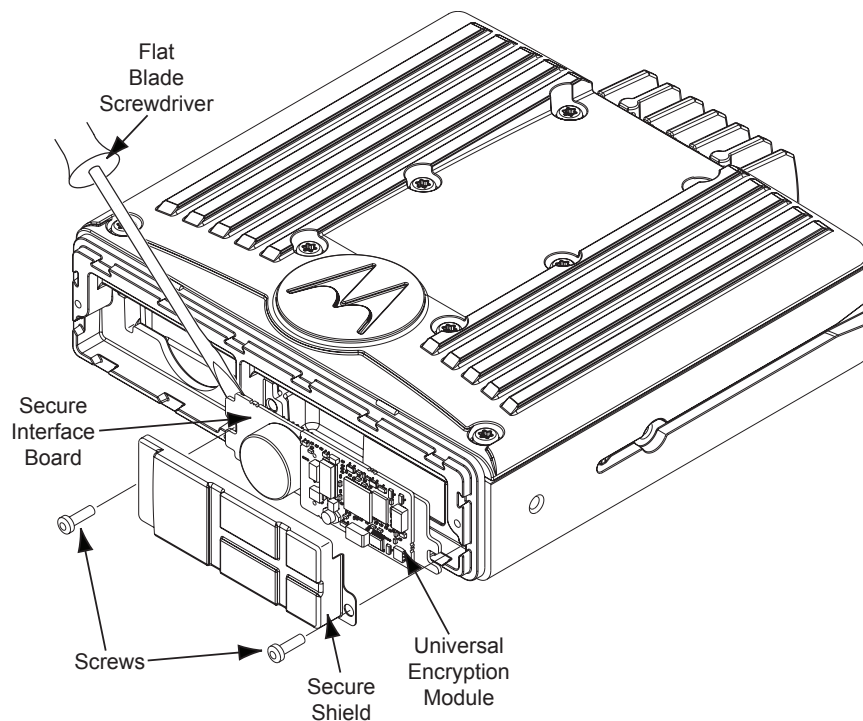


*Figure 8-15. Removing the Headbridge Seal*

**Caution**

The following steps **MUST** be performed for secure-equipped radios, prior to removal of the Main Board from the chassis. Otherwise damage to the transceiver Main Board could occur.

9. For secure option-equipped radios, do the following prior to disassembly of the transceiver:
  - a. Remove the two screws holding the secure (UCM) shield in place.
  - b. Pull the UCM shield away from the assembly and remove it.
  - c. Insert a flat-blade screwdriver into the space in the upper-left corner of the secure pocket, and gently pry the secure interface board (universal encryption module) away from the chassis.

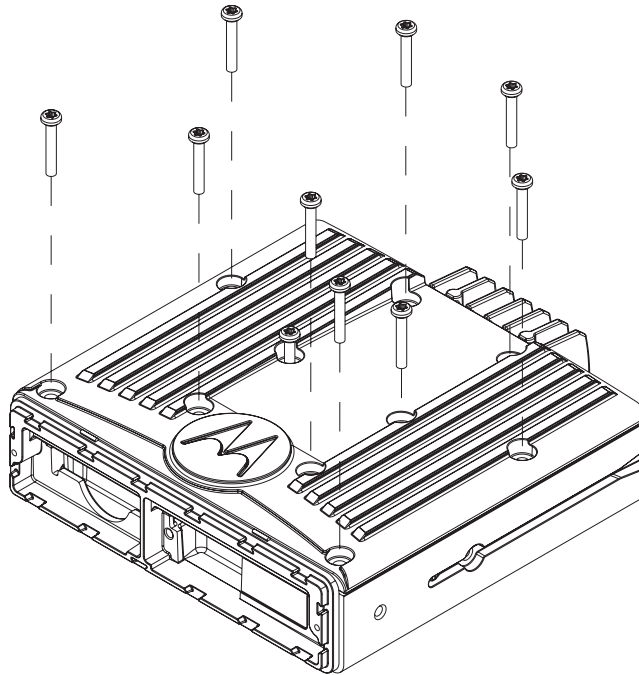


MAEPF-27658-O

*Figure 8-16. Removing the Secure Interface Board*



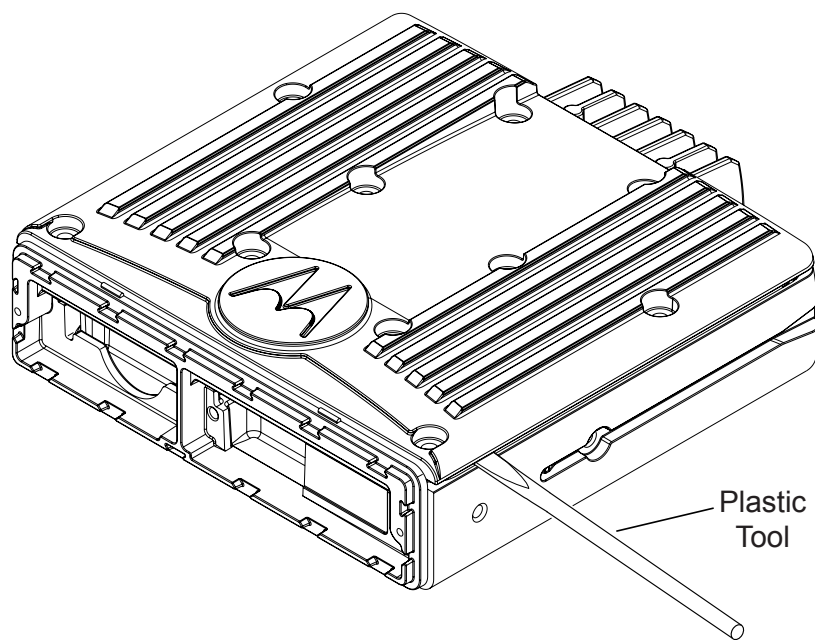
10. Remove the 10 top-cover screws using a Torx T20 bit. These screws have sealing washers that should be kept with the screw.



MAEPF-27679-0

*Figure 8-17. Removing the Top Cover Screws*

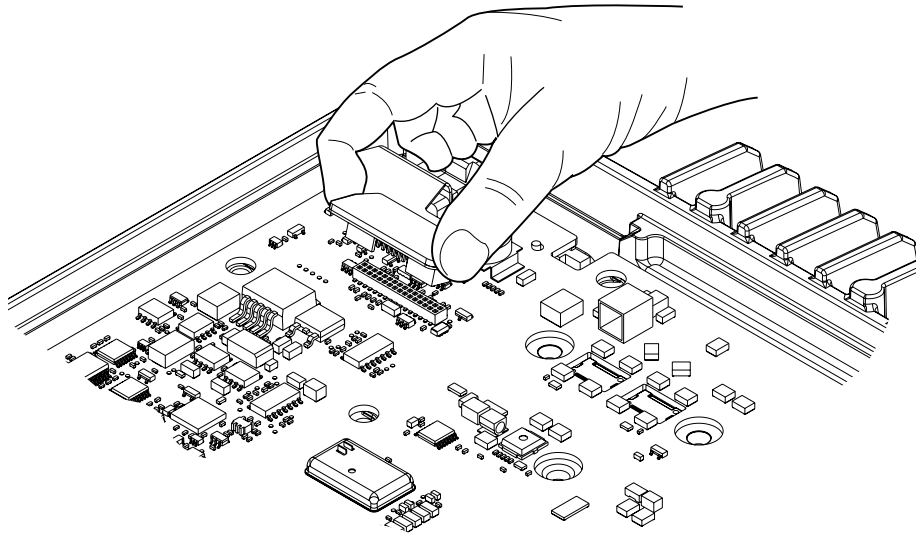
11. Remove the top cover by lifting up simultaneously on both side edges. It may be necessary to gently pry the cover off using a plastic tool.



MAEPF-27680-A

*Figure 8-18. Lifting the Top Cover*

12. Disconnect the rear accessory (J2) flex from the main board.



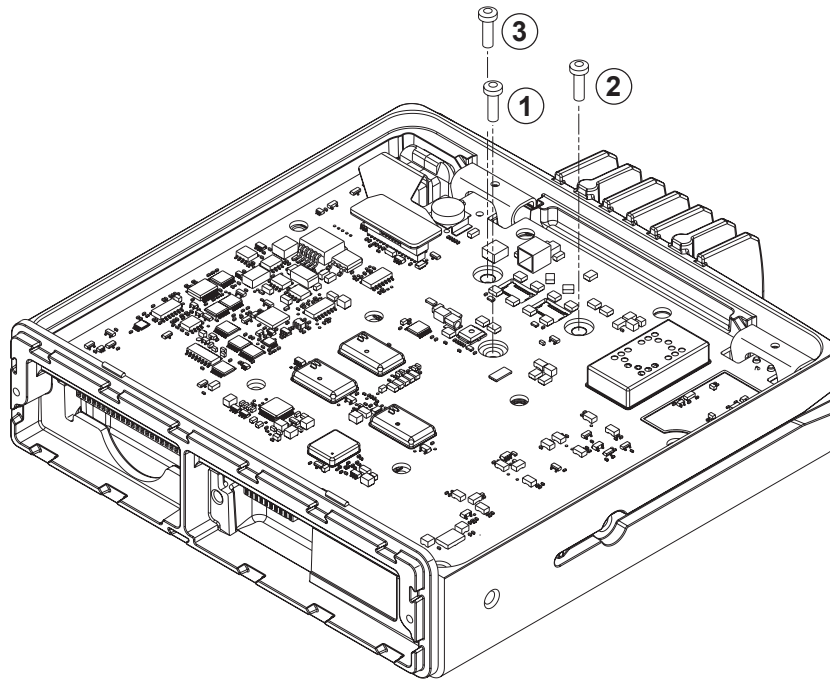
MAEPF-27681-O

*Figure 8-19. Removing the J2 Rear Accessory Flex from the Main Board*

**Caution**

The PA screws must be removed BEFORE the RF/DC retention clips or damage may occur to the PCB.

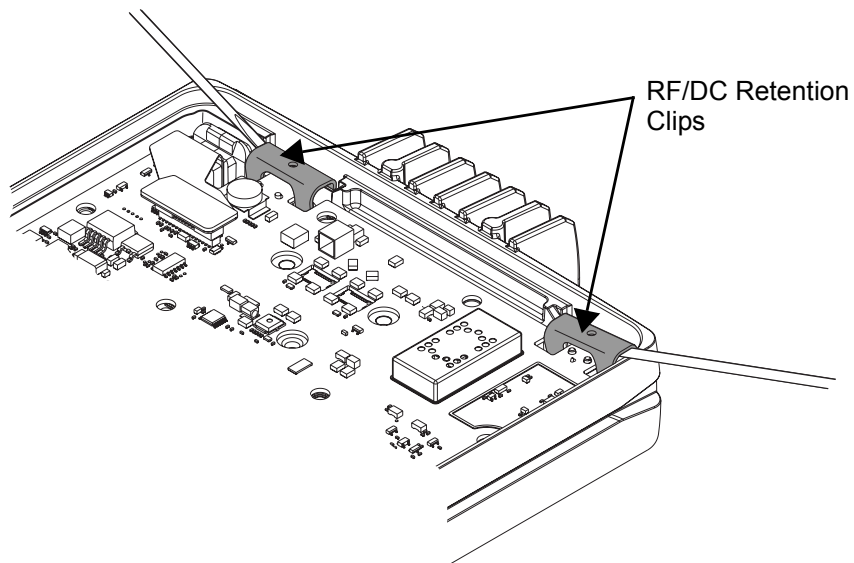
13. Remove the three PA screws in the order shown using a Torx T10 bit.



MAEPF-27682-O

*Figure 8-20. Removing the PA Screws*

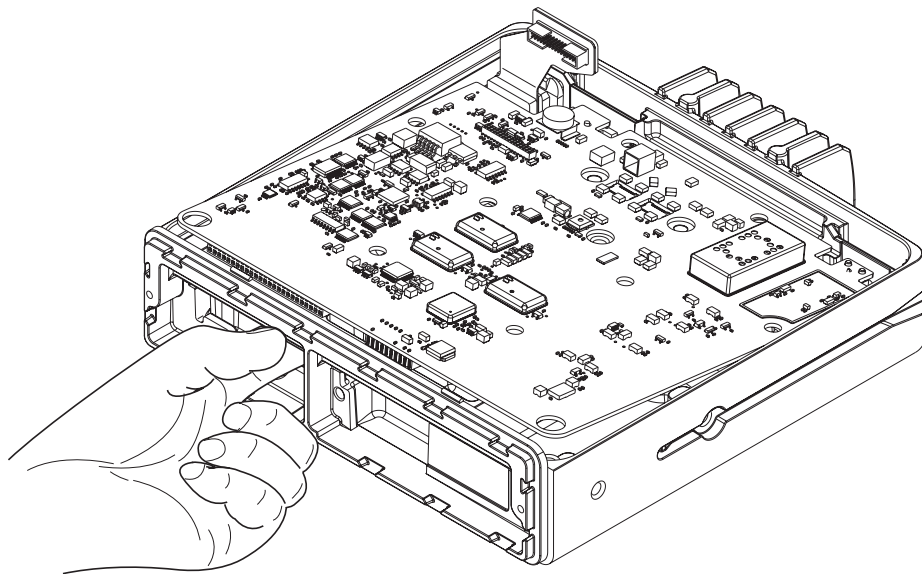
14. Remove the RF/DC retention clips by gently prying them out with a flat-blade screwdriver. For leverage, use only the slots provided immediately adjacent to the clips.



MAEPF-27684-O

*Figure 8-21. Removing the RF/DC Retention Clips*

15. Remove the main board by sliding a finger into the provided opening at the front of the chassis and gently pushing up on the 50-pin connector, lifting up the front of the PCB.



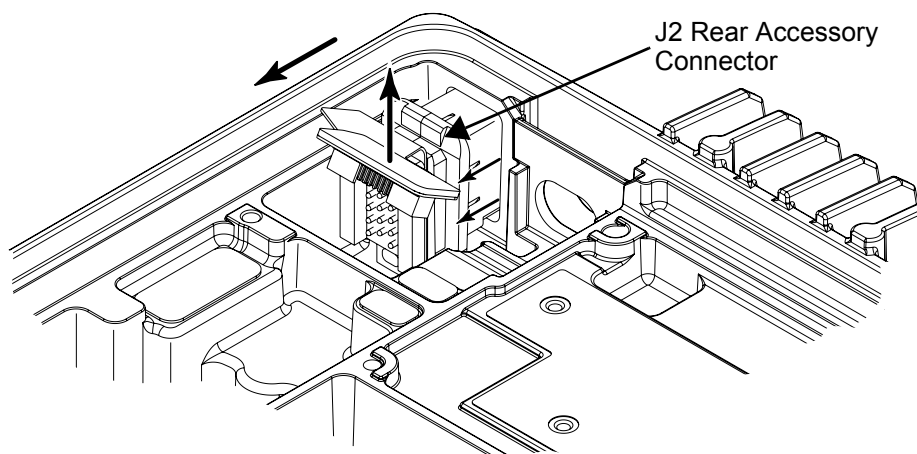
MAEPF-27683-O

*Figure 8-22. Pushing Up the Main Board*

16. Then, slide the main board towards the front of the chassis. Swing it out of the chassis. Handle the main board by the edges only, and store it in an antistatic bag.
17. Remove the J2 rear accessory connector by sliding it out of the chassis wall.

**Caution**

Do not attempt to remove the J2 accessory connector by pulling on the flex. Doing so might damage the flex.



MAEPF-27785-O

*Figure 8-23. Removing the J2 Rear Accessory Connector*

### 8.2.7.2 High Power Models

Use the following procedure to disassemble your radio:

1. Ensure all accessory connections, power, antenna, and microphone are unplugged.
2. Remove the two screws that secure the Transceiver Interface Board (TIB) housing using a T10 Torx bit. Save them for later use.

**NOTE:** For radios using a quick release trunnion, a handle is attached at this point with a 4 mm socket head bolt. The handle can be removed by unscrewing these two bolts but is not required to disassemble the radio.

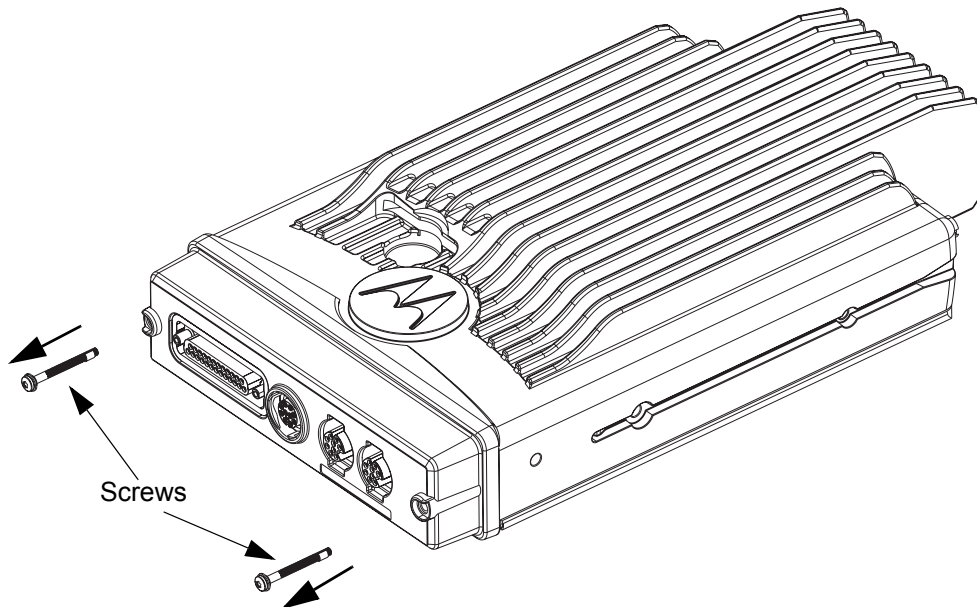
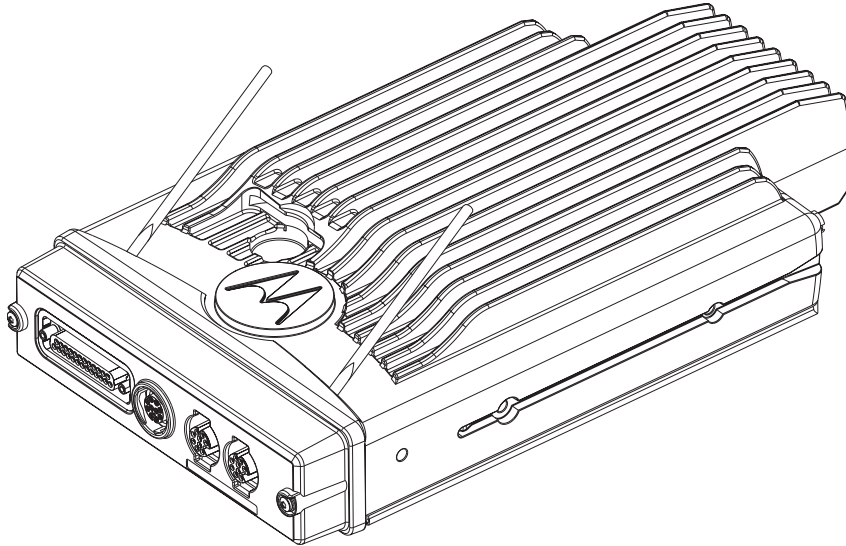


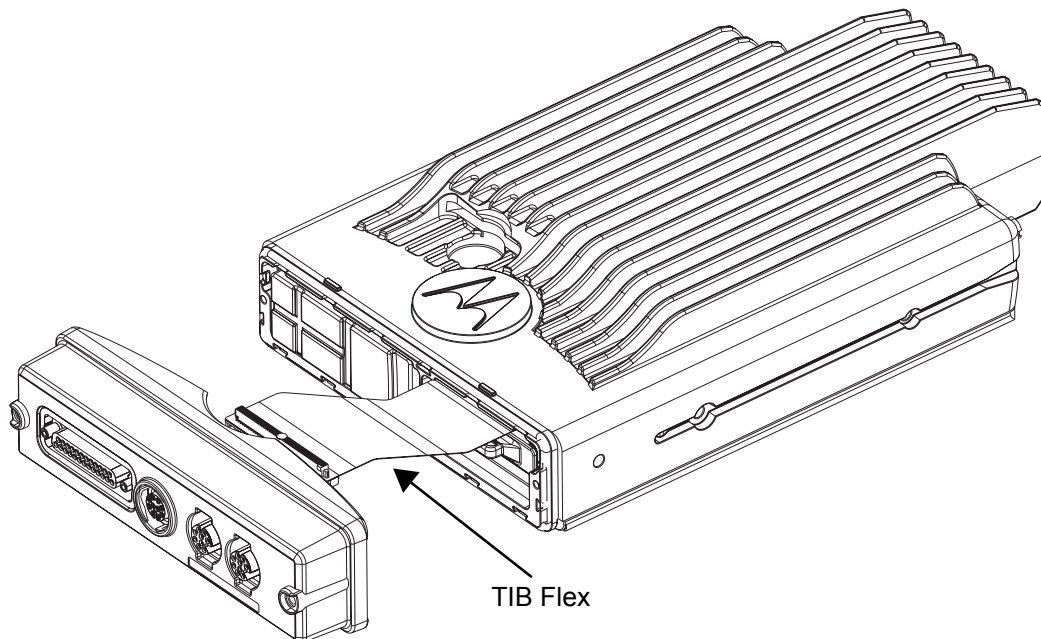
Figure 8-24. Removing the Transceiver Interface Board Screws

3. Remove the front panel by gently lifting the housing so that it disengages from the hooks underneath and lay it down on a clean, flat surface. It may be necessary to gently pry the housing free of the hooks using a plastic tool. Be careful not to pull the attached flex as the panel is being removed.



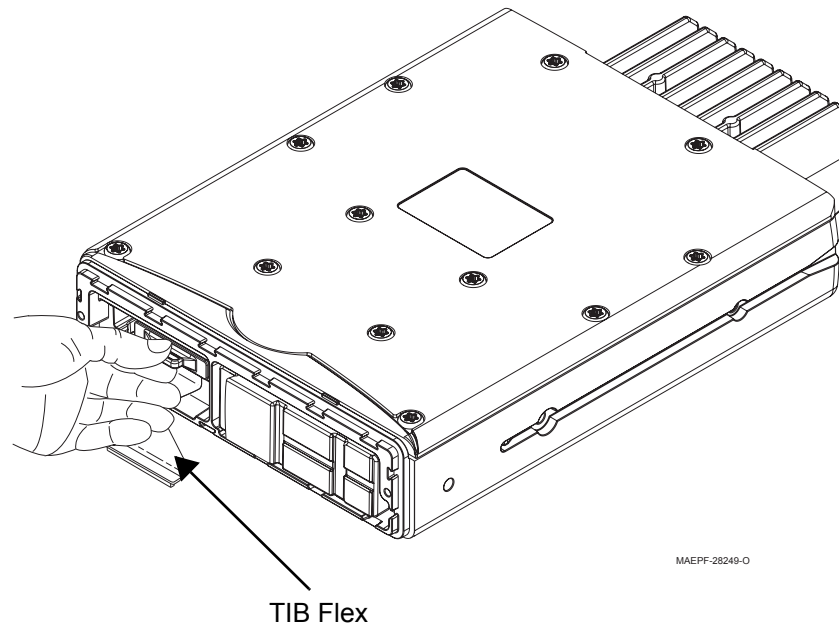
*Figure 8-25. Removing the Transceiver Interface Board Assembly*

4. Carefully disconnect the flex from the front panel, and set the panel aside.



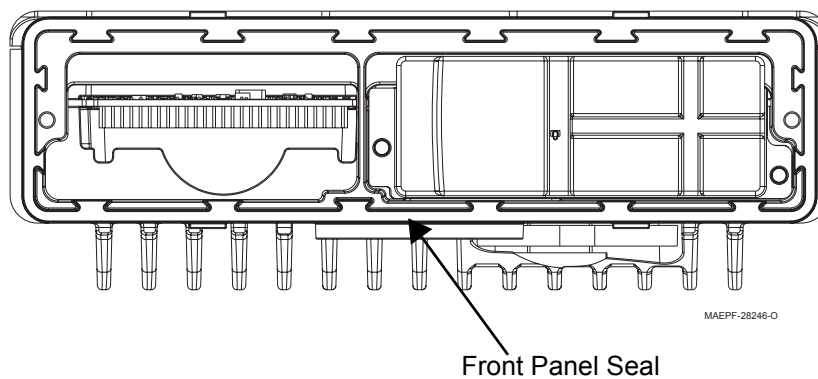
*Figure 8-26. Removing the Flex (Transceiver Interface Board Connector)*

5. Carefully remove the flex from the transceiver by grasping the provided handle and separating it from the connector.



*Figure 8-27. Removing the Flex (Main-Board Connector)*

6. Remove the front panel seal from the transceiver.

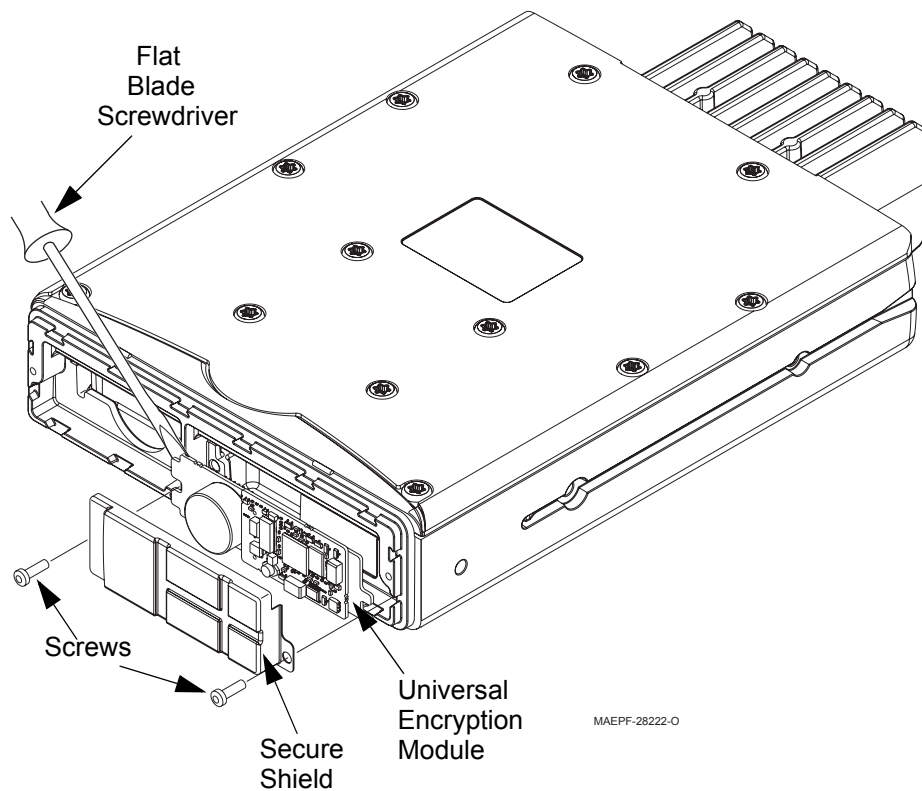


*Figure 8-28. Removing the Front Panel Seal*

**Caution**

The following steps **MUST** be performed for secure-equipped radios, prior to removal of the Main Board from the chassis. Otherwise damage to the transceiver Main Board could occur.

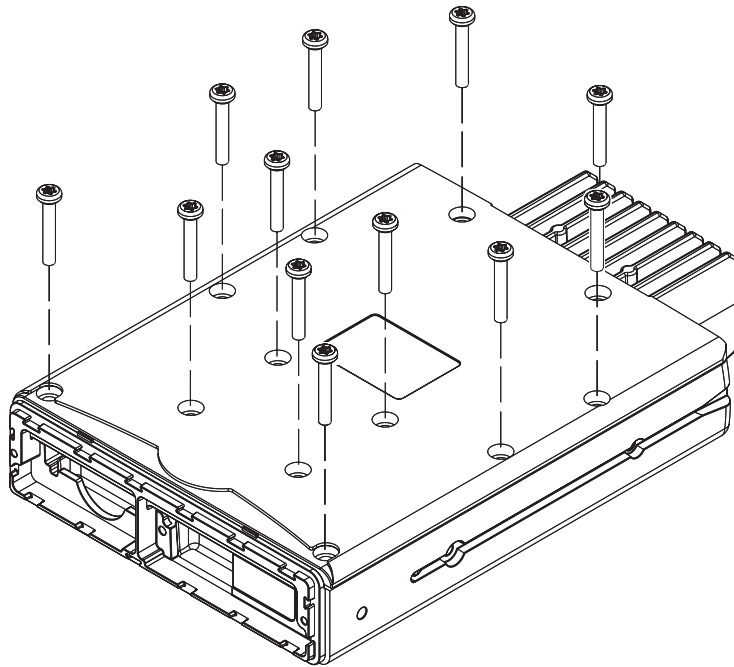
7. For secure option-equipped radios, do the following prior to disassembly of the transceiver:
  - a. Remove the two screws holding the secure (UCM) shield in place.
  - b. Pull the UCM shield away from the assembly and remove it.
  - c. Insert a flat-blade screwdriver into the space in the upper-left corner of the secure pocket, and gently pry the secure interface board (universal encryption module) away from the chassis.



*Figure 8-29. Removing the Secure Interface Board*



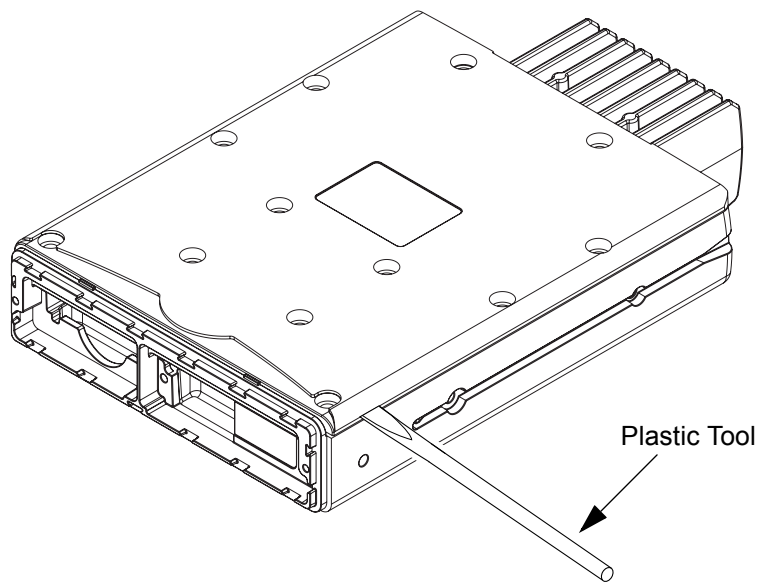
8. Remove the 12 top-cover screws using a Torx T20 bit. These screws have sealing washers that should be kept with the screw.



MAEPF-28223-O

*Figure 8-30. Removing the Top Cover Screws*

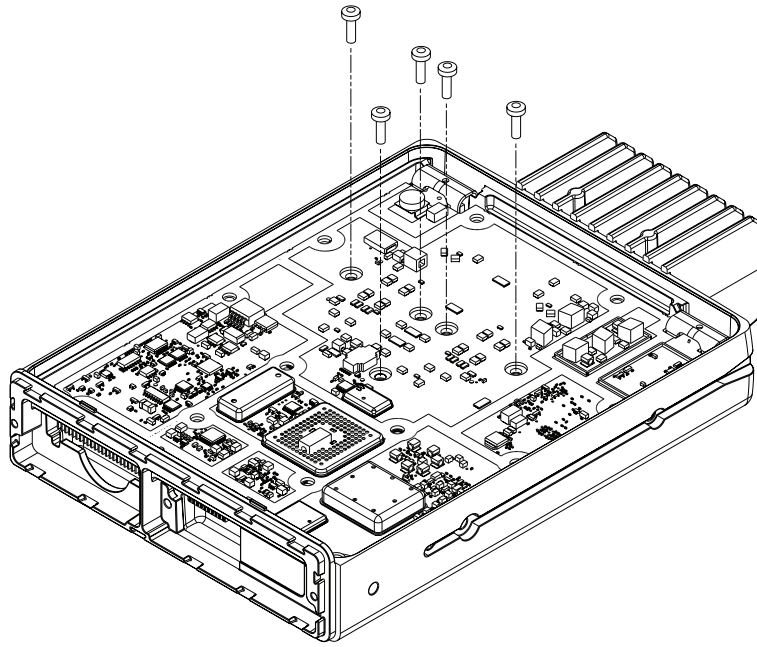
9. Remove the top cover by lifting up simultaneously on both side edges. It may be necessary to gently pry the cover off using a plastic tool.



MAEPF-28224-O

*Figure 8-31. Lifting the Top Cover*

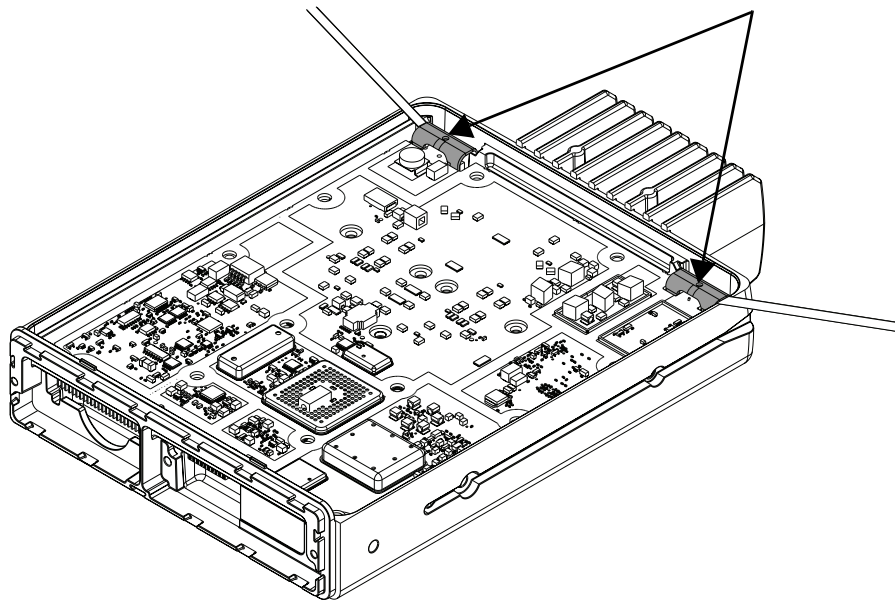
10. Remove the five PA screws in the order shown using a Torx T10 bit.



MAEPF-28225-O

*Figure 8-32. Removing the PA Screws*

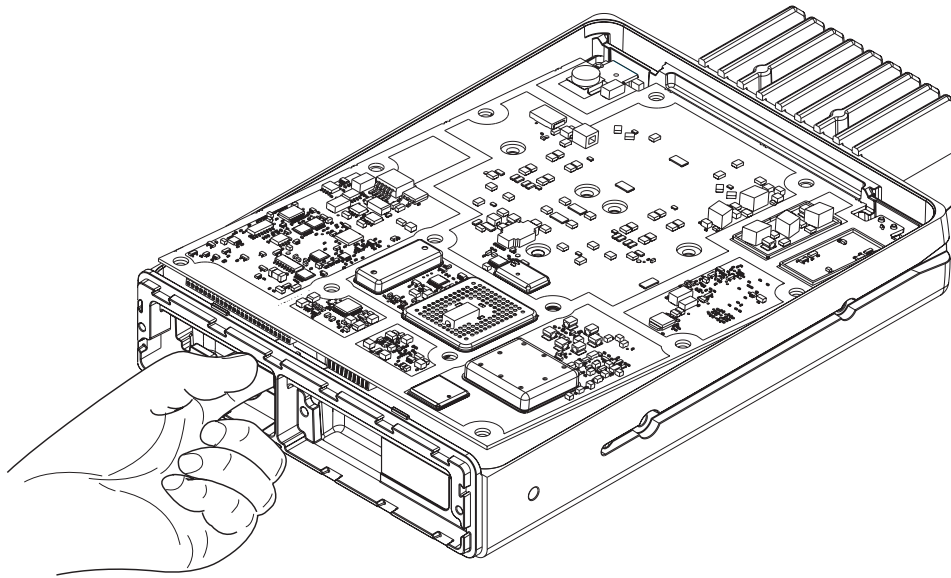
11. Remove the RF/DC retention clips by gently prying them out with a flat-blade screwdriver. For leverage, use only the slots provided immediately adjacent to the clips.



MAEPF-28226-O

*Figure 8-33. Removing the RF/DC Retention Clips*

12. Remove the main board by sliding a finger into the provided opening at the front of the chassis and gently pressing up on the 60-pin connector, lifting up the front of the PCB.



MAEPF-28227-0

*Figure 8-34. Pushing Up the Main Board*

13. Then, slide the main board towards the front of the chassis. Lift it out of the chassis. Handle the main board by the edges only, and store it in an antistatic bag.

## 8.2.8 Radio Reassembly

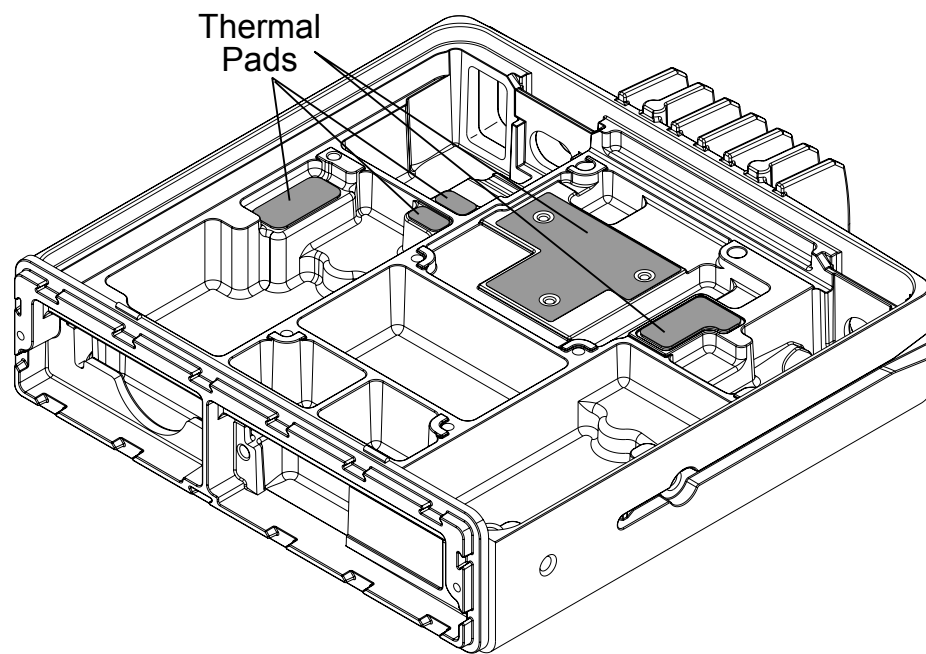
### 8.2.8.1 Mid Power Models

Use the procedure that follows to reassemble your radio.

1. Prior to reassembling the radio, inspect all seals and sealing surfaces for damage (nicks, cuts, etc.) or dirt. Refer to the exploded view bill of materials for the correct part numbers, and replace parts, as necessary. Reseat all seals on their respective parts.

Begin with the chassis. Thoroughly inspect the chassis shield gasketing for damage and verify all chassis thermal pads are in place and free of damage. See [“Chassis Thermal Pad Replacement Procedure” on page 8-41](#) to replace damaged pads.

**NOTE:** T-shaped pad is only used on some models. Some models use thermal grease instead.



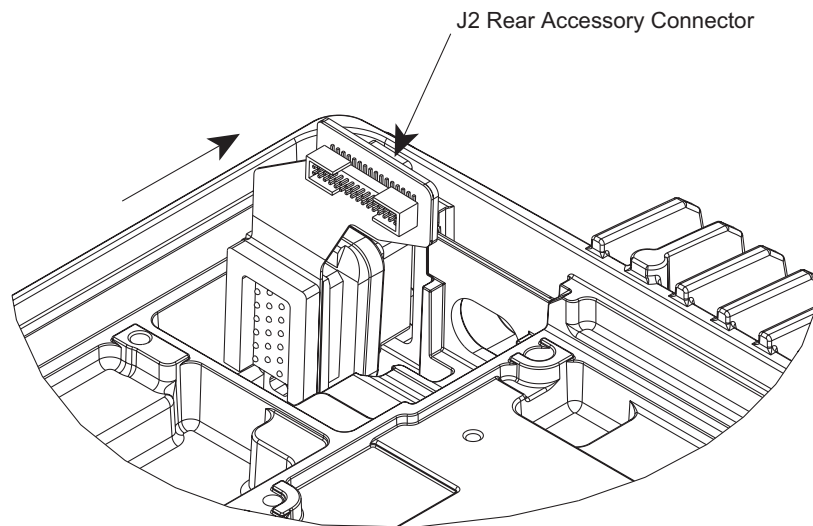
MAEPF-27685-Q

*Figure 8-35. Inspecting the Chassis Shield Gasketing and Thermal Pads*

2. After inspecting and seating the seal properly on the connector, insert the J2 rear accessory connector into the chassis and slide it into place.



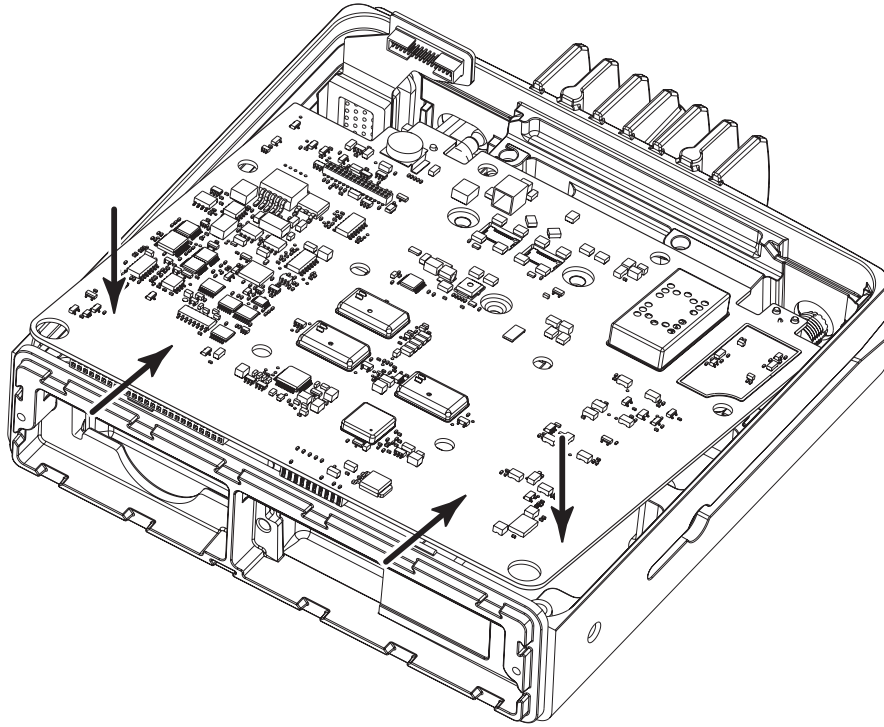
Do not attempt to insert the J2 rear accessory connector by holding onto the flex. Doing so might damage the flex.



*Figure 8-36. Inserting the J2 Rear Accessory Connector*

3. Tilt the main board and slide it into place, taking care to line up the RF and DC connectors with the holes in the back of the chassis. Push back and down on the front of the main board to fully seat it.

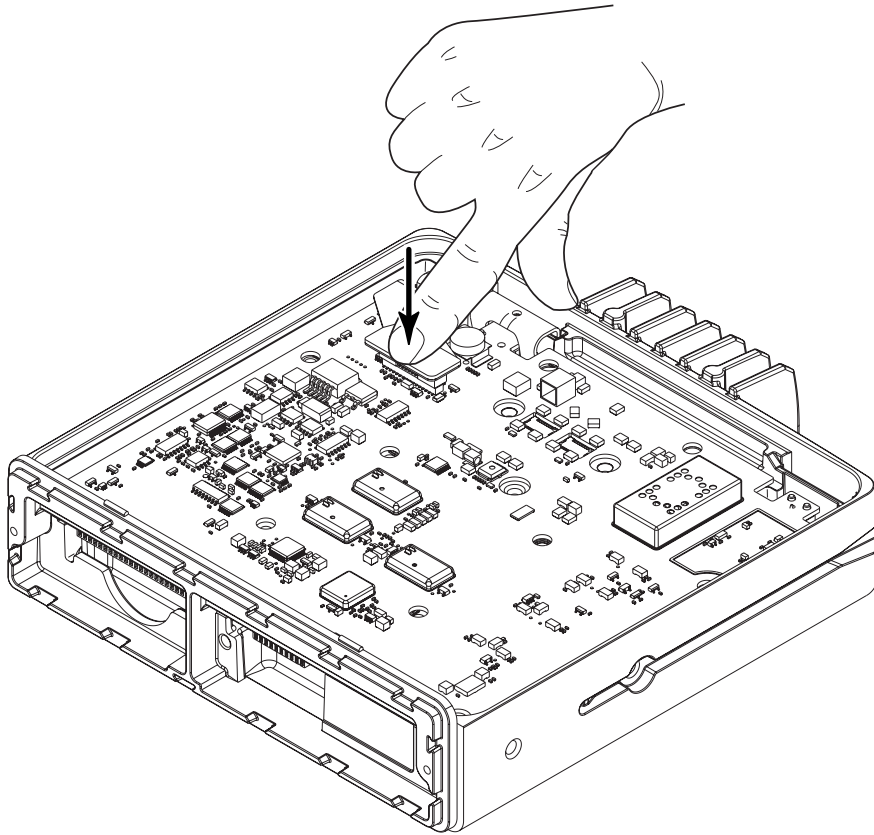
Ensure that the main board alignment holes are positioned over the chassis alignment bosses and that the main board is fully seated.



MAEPF-27687-O

*Figure 8-37. Inserting the Main Board into the Chassis*

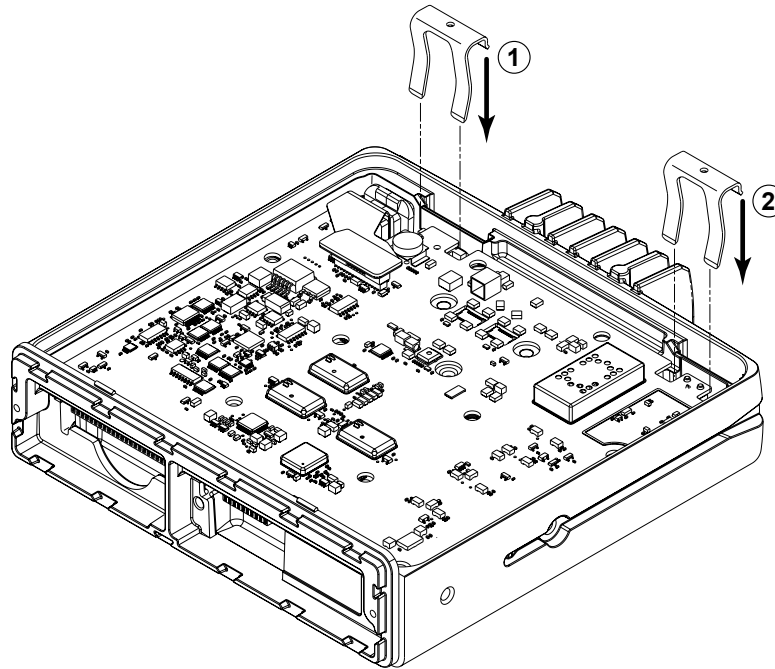
4. Connect the J2 rear accessory connector flex to the main board.



MAEPF-27784-O

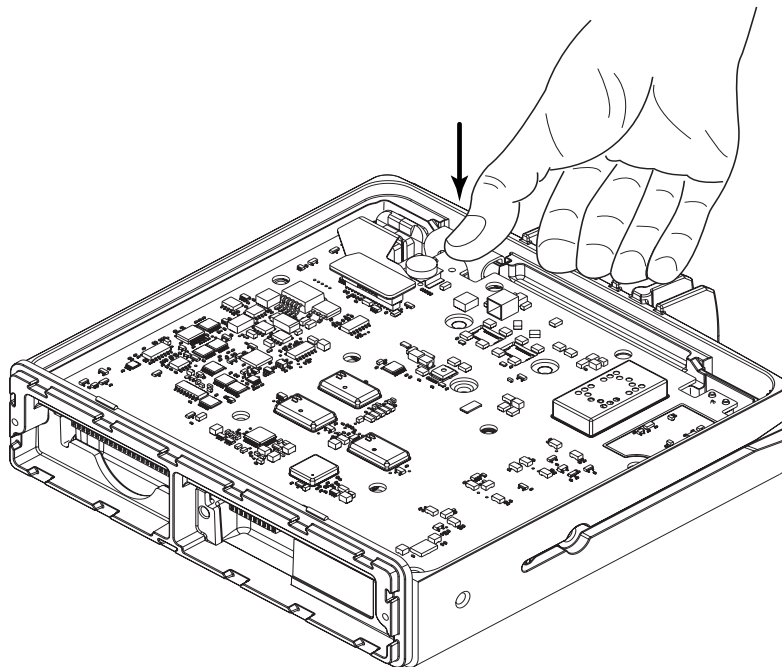
*Figure 8-38. Connecting the J2 Rear Accessory Connector Flex to the Main Board*

5. Insert the RF/DC retention clips and fully seat them. The DC clip should be inserted first to properly locate the main board.



MAEPF-27688-O

Figure 8-39. Inserting the RF/DC Retention Clips

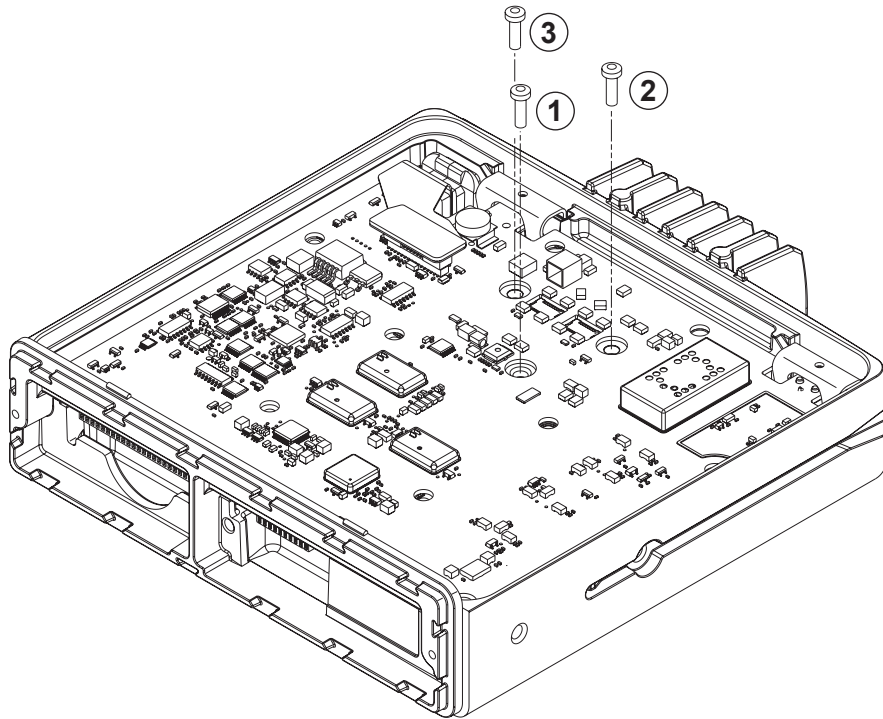


MAEPF-27689-O

Figure 8-40. Inserting the RF/DC Retention Clip (DC Side)



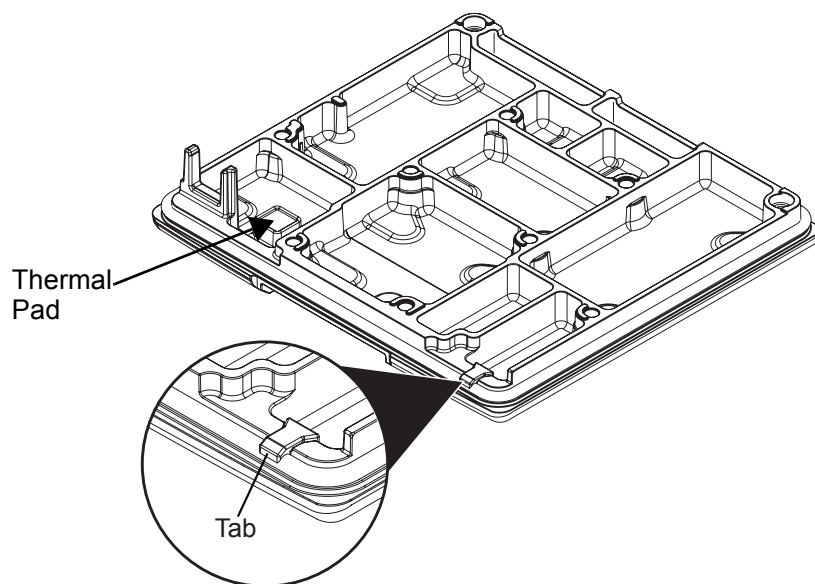
6. Insert and torque the three PA screws to 6-8 in.-lbs. Start all three screws prior to torquing them down.



MAEPF-27682-O

Figure 8-41. Installing the PA Screws

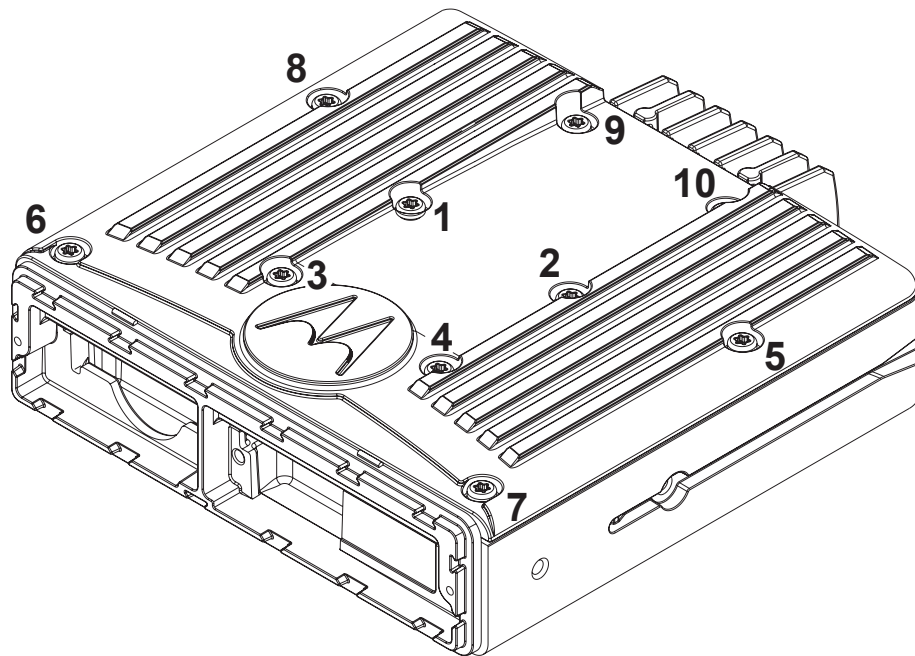
7. Inspect the reverse polarity thermal pad for the reverse polarity diode located on the top cover, and then inspect and seat the main seal properly on the cover. Be careful to properly align the tab (see figure below).



MAEPF-27686-O

Figure 8-42. Inspecting the Thermal Pad and Installing the Cover Main Seal

8. Place the cover on the chassis and seat it properly. You can compress the cover and chassis together to squeeze the seal into place, seat the seal and make torquing the screws easier.
9. Inspect and reassemble the sealing washers to the ten (10) top cover screws, and then torque down screws in the indicated order. Down the screws to 24-28 in.-lbs in the indicated order shown in [Figure 8-43](#). To ensure a proper seating of the top cover, repeat torque sequence at least twice!



MAEPF-27691-O

*Figure 8-43. Securing the Top Cover to the Chassis*

10. For secure option-equipped radios, do the following:
  - a. Inspect the kapton tape on the back of the secure interface board for damage and replace if necessary.
  - b. Ensure the universal encryption module (UCM) is securely plugged into the secure interface board.
  - c. Carefully align the secure interface board in its chassis pocket, and plug it into the main board. Press down along the edges of the board to fully seat it, and then verify that the UCM is still fully plugged in.
  - d. Position the secure shield over the secure interface board, and secure it with the two screws. Torque the screws to 6-8 in.-lbs. using a Torx T10 bit.

- e. Over-torque of the shield screws will strip out the threads inside chassis. Repair will require re-tapping of the threading.

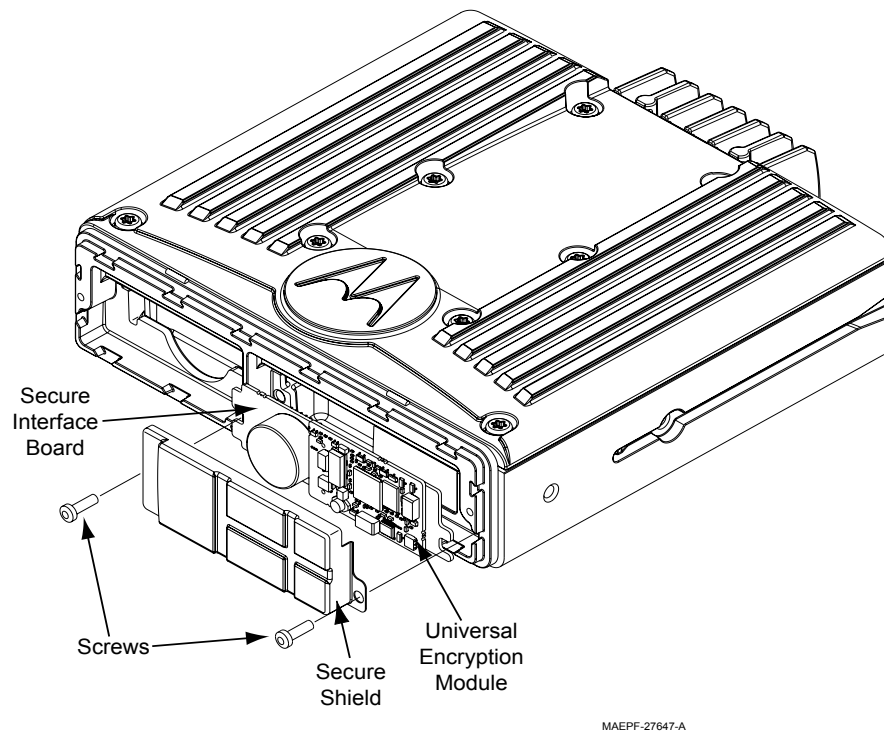


Figure 8-44. Installing the Secure Interface Board

11. Verify that the headbridge seal has no defects; replace the seal if it does.
12. Align the headbridge seal on the transceiver, and insert the seal tabs into their slots along the front edge of the transceiver (Figure 8-45 on page 8-32). Ensure that all the seal tabs are in place.

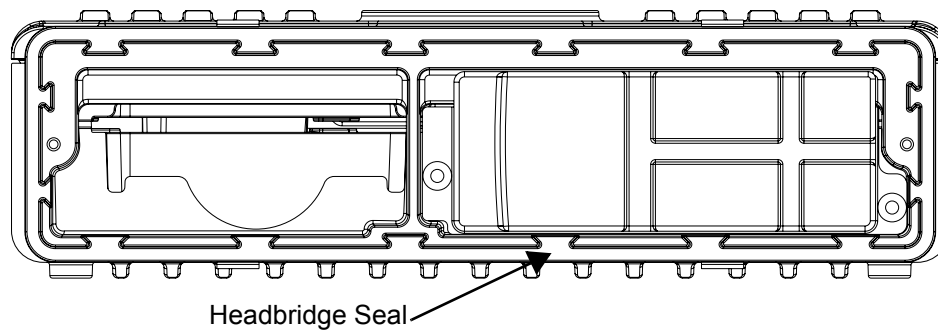
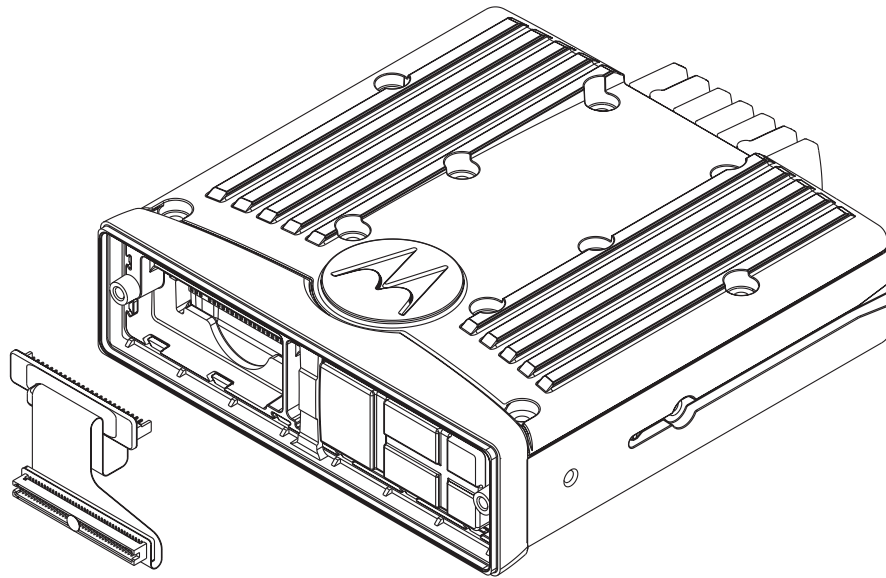


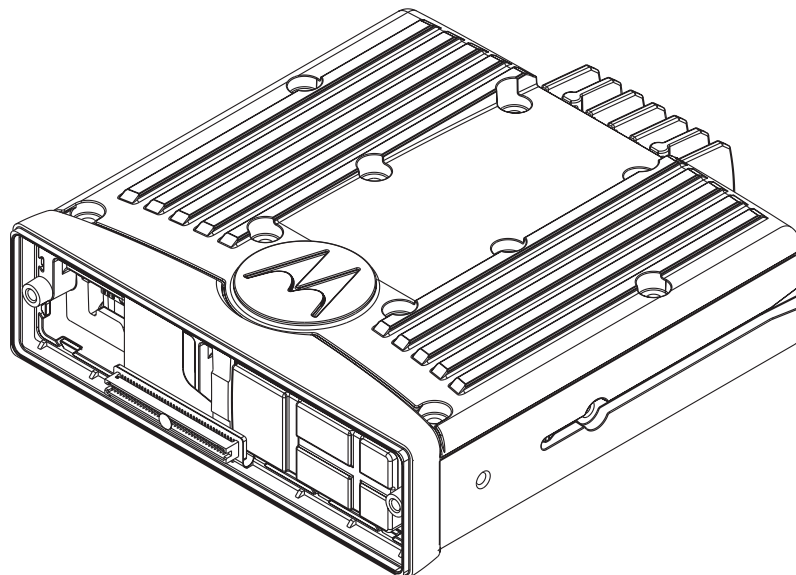
Figure 8-45. Installing the Headbridge Seal

13. Grasp the handle on the transceiver end of the control head flex, or TIB flex if remote, and plug the flex into the 50-pin connector on the side of the main board.



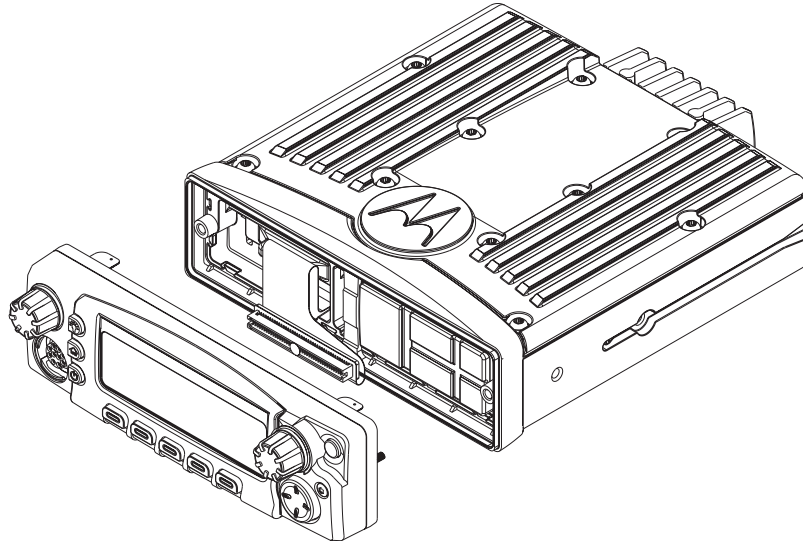
*Figure 8-46. Installing the control head Flex in the Transceiver*

14. Hold the headbridge with one hand, and squeeze the center of the long span.
15. Align the headbridge with the transceiver, thread the flex through the headbridge, and push the headbridge into place. You might hear a small snap as the alignment tabs engage. If the headbridge does not align properly on the first try, do not try to slide it back and forth on the transceiver. This will cause the seal to roll out of place. Instead, remove the headbridge and try again, taking care to align it properly before fully seating it.



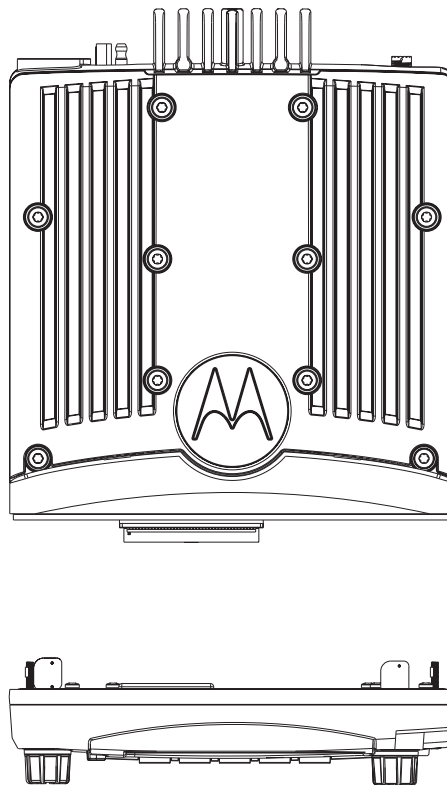
*Figure 8-47. Installing the Headbridge on the Transceiver*

16. Verify that the headbridge seal and all the seal tabs are properly in place.
17. Reinstall the control head flex onto the control head connector or TIB flex onto the TIB connector.



*Figure 8-48. Installing the Control Head Flex on the Control Head*

18. Insert the control head to the transceiver.



*Figure 8-49. Inserting the Control Head Into the Transceiver*

19. Secure the control head to the transceiver with the two screws using the T-10. Apply 6-8 in.-lbs. of torque for each screw.

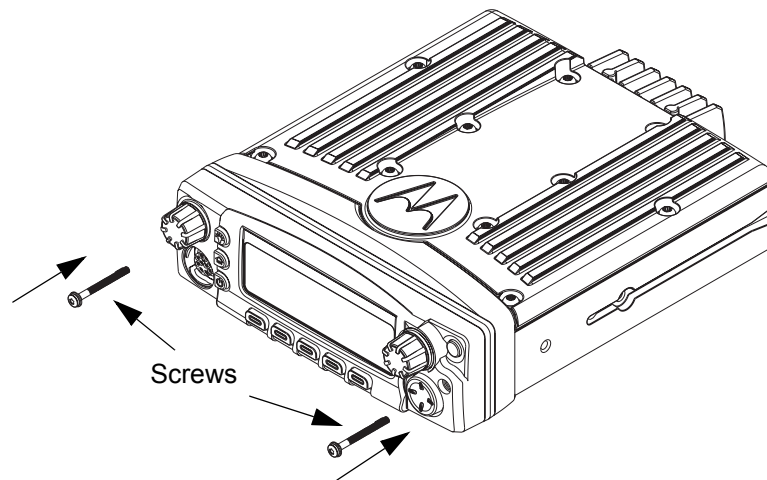


Figure 8-50. Installing the Control Head Screws

### 8.2.8.2 High Power Models

Use the procedure that follows to reassemble your radio.

1. Prior to reassembling the radio, inspect all seals and sealing surfaces for damage (nicks, cuts, etc.) or dirt. Refer to the exploded view bill of materials for the correct part numbers, and replace parts, as necessary. Reseat all seals on their respective parts.

Begin with the chassis. Thoroughly inspect the chassis shield gasketing for damage and verify all chassis thermal pads are in place and free of damage. [See “Chassis Thermal Pad Replacement Procedure” on page 8-41](#) to replace damaged pads.

**NOTE:** This rectangular recess contains thermal grease.

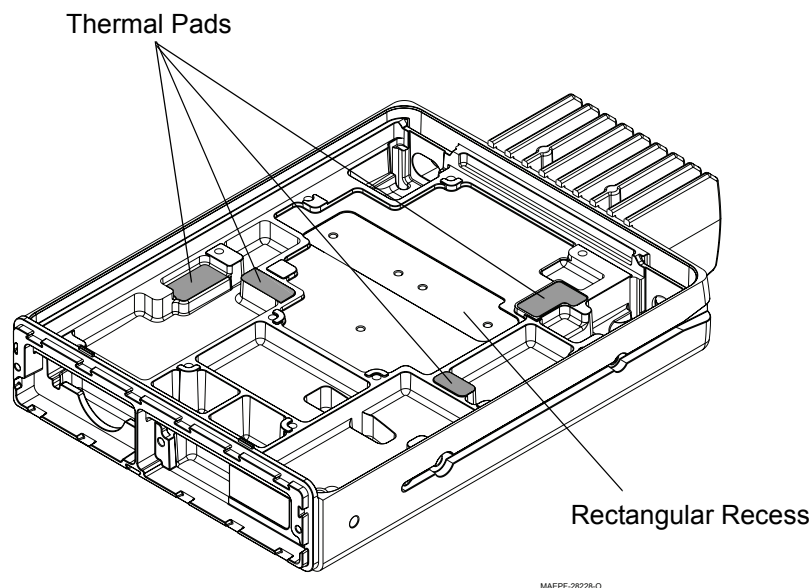
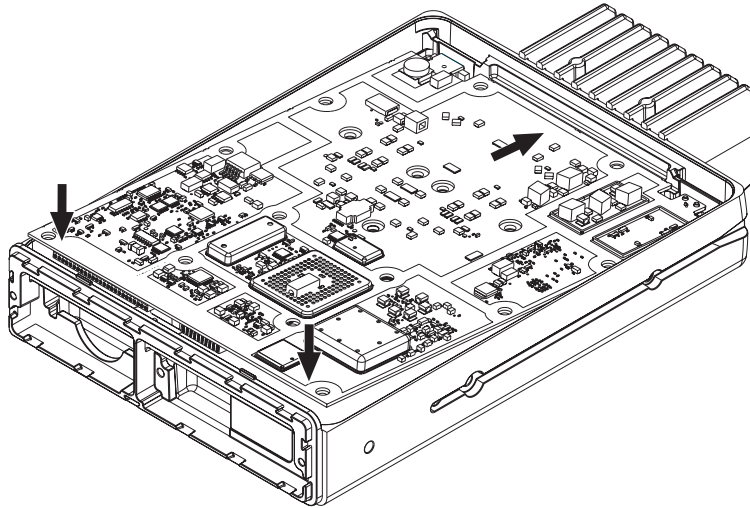


Figure 8-51. Inspecting the Chassis Shield Gasketing and Thermal Pads

2. Tilt the main board and slide it into place, taking care to line up the RF and DC connectors with the holes in the back of the chassis. Push back and down on the front of the main board to fully seat it.

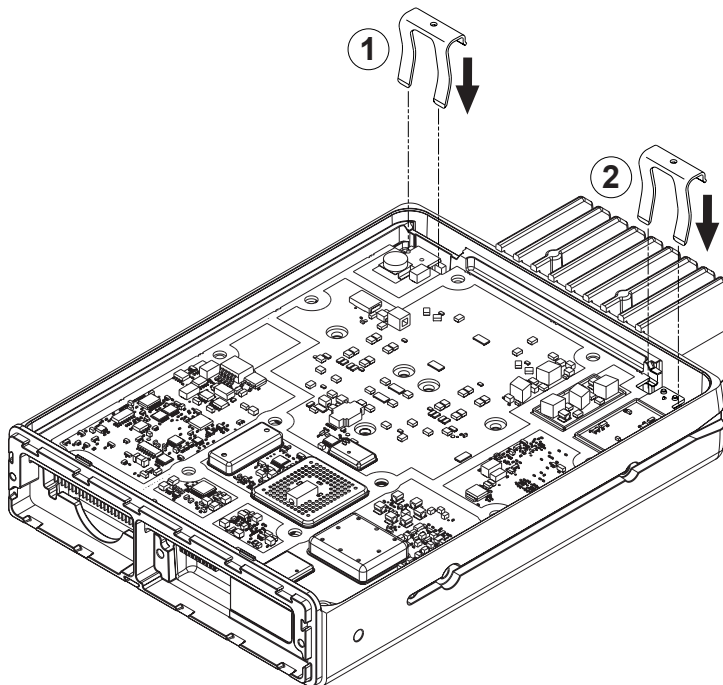
Ensure that the main board alignment holes are positioned over the chassis alignment bosses and that the main board is fully seated.



MAEPF-26229-0

Figure 8-52. Inserting the Main Board into the Chassis

3. Insert the RF/DC retention clips and fully seat them. The DC clip should be inserted first to properly locate the main board.



MAEPF-26230-0

Figure 8-53. Inserting the RF/DC Retention Clips



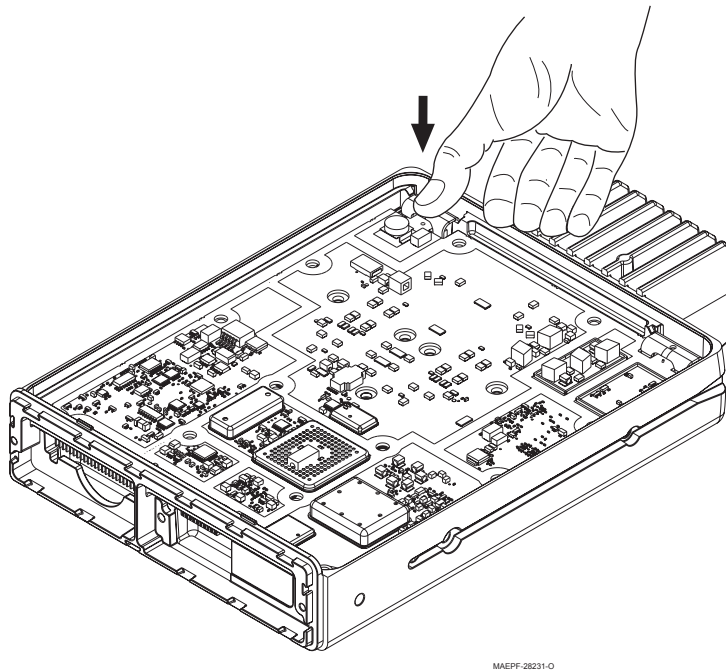


Figure 8-54. Inserting the RF/DC Retention Clip (DC Side)

4. Insert and torque the five PA screws to 6-8 in.-lbs. Start all five screws prior to torquing them down.

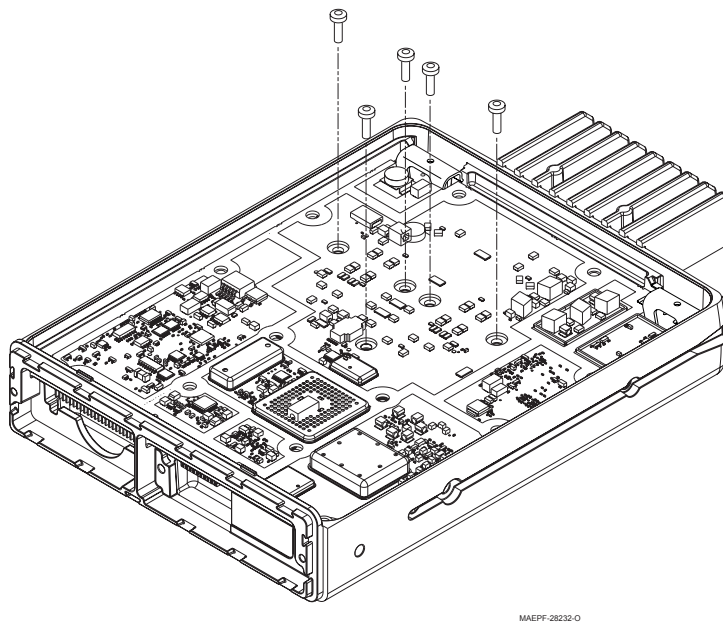
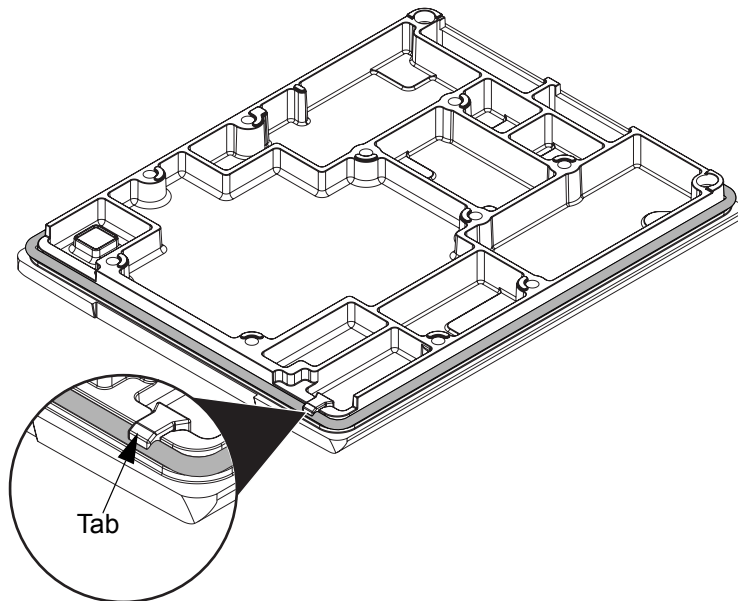


Figure 8-55. Installing the PA Screws



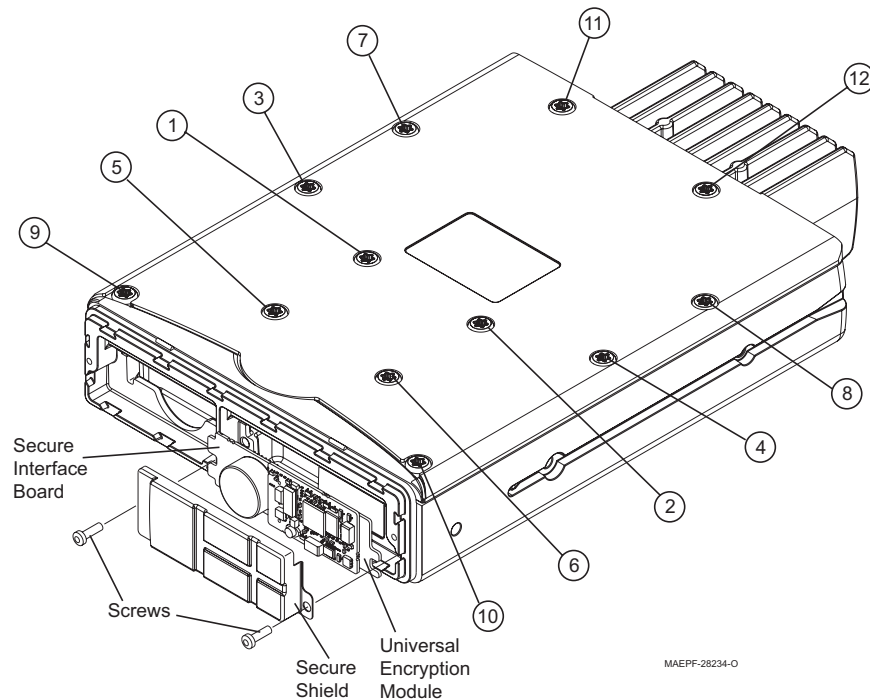
5. Inspect the reverse polarity thermal pad for the reverse polarity diode located on the top cover, and then inspect and seat the main seal properly on the cover. Be careful to properly align the tab (see figure below).



*Figure 8-56. Inspecting the Thermal Pad and Installing the Cover Main Seal*

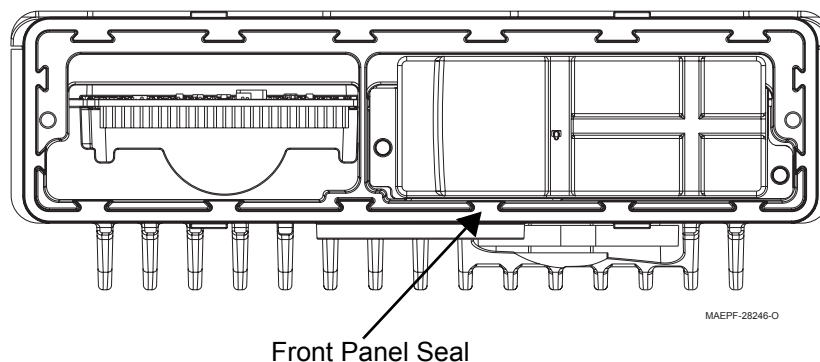
6. Place the cover on the chassis and seat it properly. You can compress the cover and chassis together to squeeze the seal into place, seat the seal and make torquing the screws easier.
7. Inspect and reassemble the sealing washers to the twelve (12) top cover screws, and then torque down screws in the indicated order. Down the screws to 24-28 in.-lbs in the indicated order shown in [Figure 8-57](#). To ensure a proper seating of the cover, repeat torque sequence at least twice!
8. For secure option-equipped radios, do the following:
  - a. Inspect the kapton tape on the back of the secure interface board for damage and replace if necessary.
  - b. Ensure the universal encryption module (UCM) is securely plugged into the secure interface board.
  - c. Carefully align the secure interface board in its chassis pocket, and plug it into the main board. Press down along the edges of the board to fully seat it, and then verify that the UCM is still fully plugged in.
  - d. Position the secure shield over the secure interface board, and secure it with the two screws. Torque the screws to 6-8 in.-lbs. using a Torx T10 bit.

- e. Over-torque of the shield screws will strip out the threads inside chassis. Repair will require re-tapping of the threading.



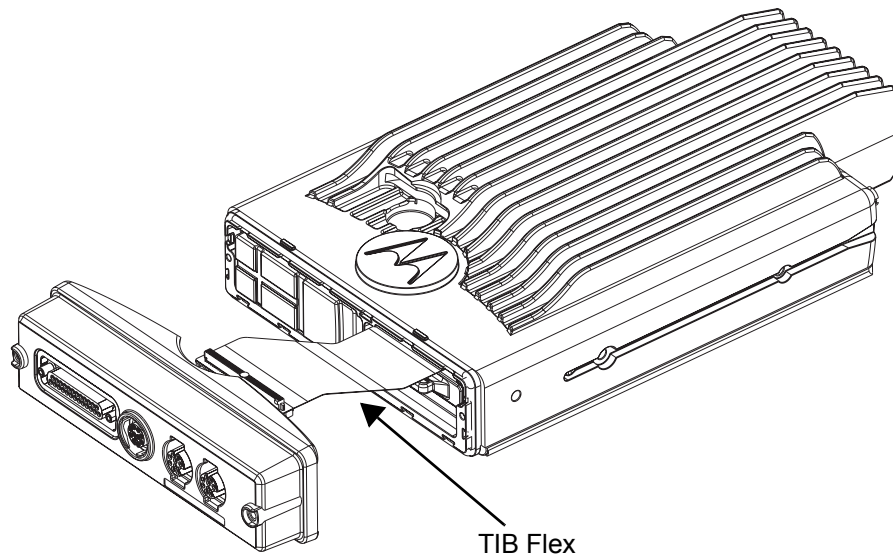
*Figure 8-57. Installing the Secure Interface Board*

9. Verify that the front panel seal has no defects; replace the seal if it does.
10. Align the front panel seal on the transceiver, and insert the seal tabs into their slots along the front edge of the transceiver ([Figure 8-58 on page 8-39](#)). Ensure that all the seal tabs are in place.



*Figure 8-58. Installing the Front Panel Seal*

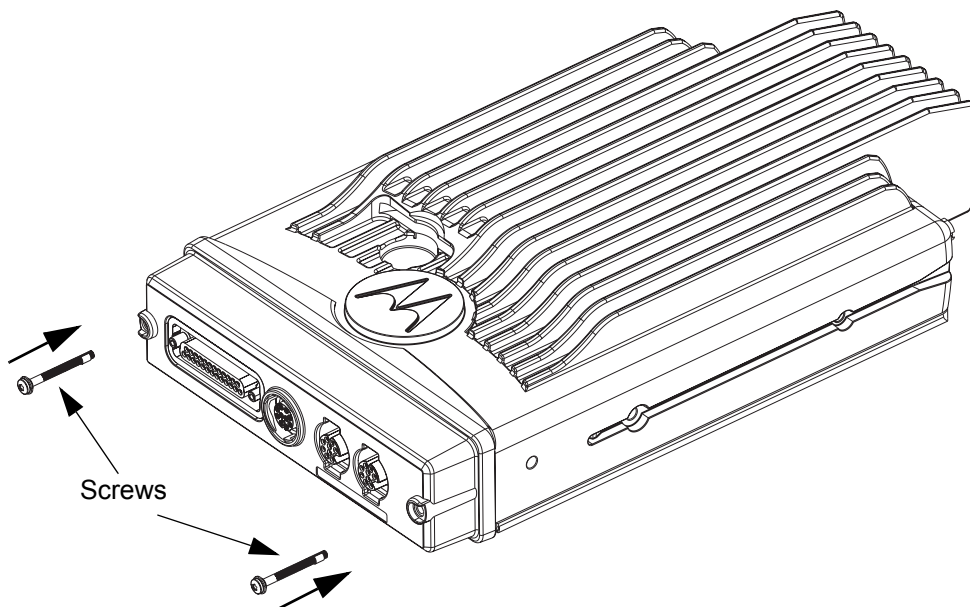
11. Grasp the handle on the transceiver end of the Transceiver Interface Board (TIB) flex, and plug the flex into the 60-pin connector on the side of the main board.



*Figure 8-59. Installing the TIB Flex in the Transceiver*

12. Hold the TIB assembly with one hand and connect the TIB flex to the TIB connector. Align the TIB assembly with the transceiver and push it into place, being careful not to roll or pinch the TIB assembly seal. You might hear a small snap as the alignment hooks engage. If the TIB assembly does not align properly on the first try, do not try to slide it back and forth on the transceiver. This will cause the seal to roll out of place. Instead, remove the TIB assembly and try again, taking care to align it properly before fully seating it.
13. Secure the TIB assembly to the transceiver with the two screws using the 2.5 mm hex-key bit torque driver with a T-10 Torx bit. Apply 6-8 in.-lbs. of torque for each screw.

**NOTE:** Quick Release handle is not shown.

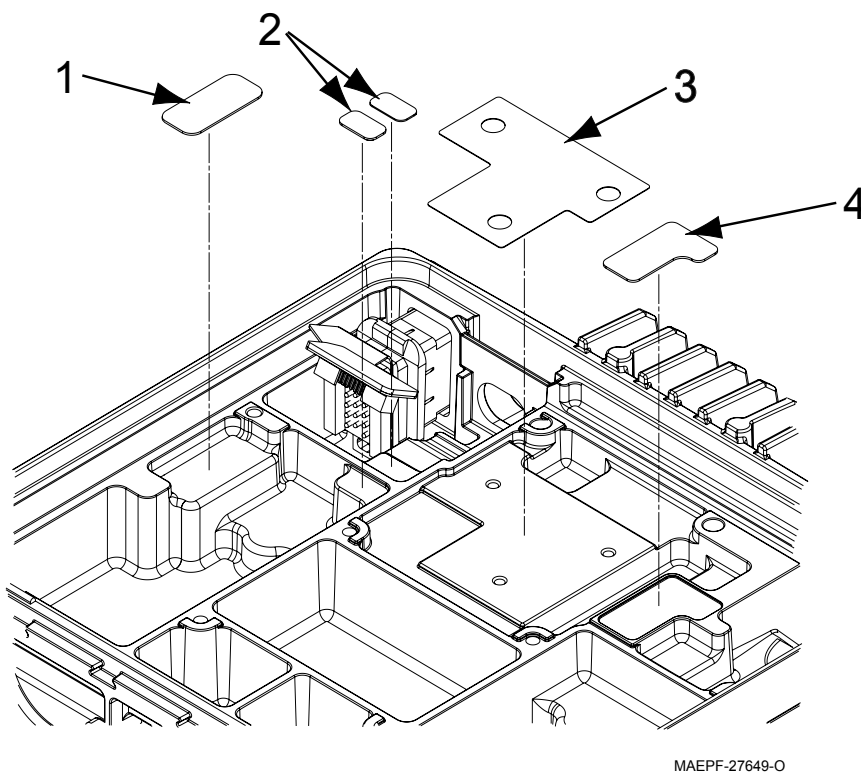


*Figure 8-60. Installing the Transceiver Interface Board Assembly Screws*

## 8.3 Chassis Thermal Pad Replacement Procedure

### 8.3.1 Mid Power Models

Use the following procedures for replacing the chassis thermal pads.



MAEPF-27649-O

Figure 8-61. Chassis Thermal Pad Locations

Table 8-2. Chassis Thermal Pad Parts

Item No.	Part No.	Description
1	7585366E01	Pad, Thermal, Audio PA
2	7585477E01	Pad, Thermal, Regulator
3	7585365E02	Pad, Thermal, Power Amplifier
4	7585476E01	Pad, Thermal, Harmonic Filter

To replace the pink thermal pads (Items 1, 2, and 4):

1. Use a plastic flat-edge tool (like a black-stick solder aid) to lift the pad from the chassis surface.
2. Discard the old pad. Use a soft cloth to remove any remaining residue. Alcohol can also be used, if necessary. Care should be taken to minimize any cleaning-agent contact with the surrounding shield gasket.
3. Once the surface is clean and dry, use tweezers to remove a new pad from the shipping liner, and place it yellow-side down on the chassis.

4. Apply pressure to the pad to activate the pressure-sensitive adhesive. Remove the blue liner with tweezers.

To repair the black thermal pad (Item 3):

1. Use a plastic flat-edge tool (like a black-stick solder aid) to lift the pad from the chassis surface. The pad is an elastomer-coated sheet of foil. The foil sheet will lift off in pieces. The black elastomer residue will remain on the chassis.
2. Scrape the residue off using a plastic flat-edge tool, such as a dismantling tool (Motorola P/N 6686119B01).



**Caution**

Use of a metal tool will scratch the heat sink surface and reduce the thermal effectiveness of the thermal pad which is used to heat sink heat-sensitive components. Loss of thermal effectiveness of the thermal pads could result in the overheating of heat-sensitive radio components and result in their damage.

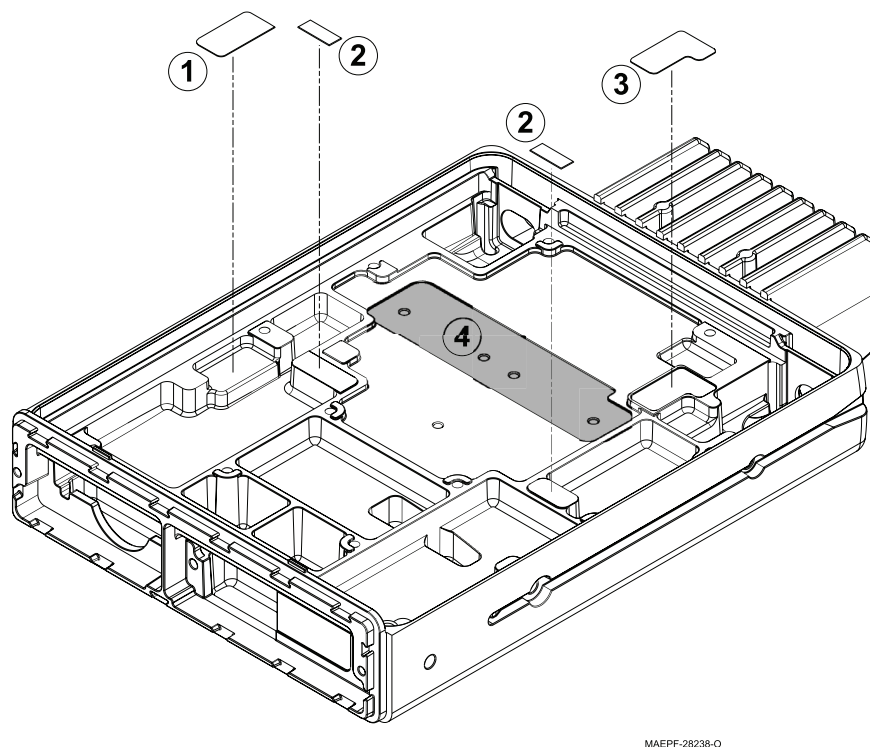
3. After scraping off as much residue as possible, use a soft cloth with alcohol to remove the remaining residue. Care should be taken to minimize any cleaning-agent contact with the surrounding shield gasket.
4. Once the surface is clean and dry, use tweezers to remove a new pad from the shipping liner.
5. Position the pad on the chassis using any two screw holes as a visual cue.
6. Carefully place the pad down to avoid wrinkling the pad or trapping air bubbles under the pad.
7. Apply even pressure to activate the pressure-sensitive adhesive.

To repair the cover pad (7585060F01) shown in the exploded view, [11.6 "XTL 5000 O5 Dash Mount Radio Exploded View" on page 11-7](#):

1. Use a plastic flat-edge tool (like a black-stick solder aid) to lift the pad from the top cover boss.
2. Discard the old pad, and use a soft cloth to remove any remaining residue. Alcohol can also be used, if necessary. Care should be taken to minimize any cleaning-agent contact with the surrounding shield gasket.
3. Once the surface is clean and dry, use tweezers to remove the blue liner from the pad.
4. Place the pad pink-side-down on the cover boss.
5. Use your finger to apply pressure to the pad. The yellow side is visible when the pad is installed correctly.

### 8.3.2 High Power Models

Use the following procedures for replacing the chassis thermal pads.



MAEPF-28238-O

Figure 8-62. Chassis Thermal Pad Locations

Table 8-3. Chassis Thermal Pad Parts

Item No.	Part No.	Description
1	7585366E01	Pad, Thermal, Audio PA
2	7585477E01	Pad, Thermal, Regulator
3	7585476E01	Pad, Thermal, Harmonic Filter
4	1110022D23	Thermal Grease

To replace the pink thermal pads (Items 1, 2, and 3):

1. Use a plastic flat-edge tool (like a black-stick solder aid) to lift the pad from the chassis surface.
2. Discard the old pad. Use a soft cloth to remove any remaining residue. Alcohol can also be used, if necessary. Care should be taken to minimize any cleaning-agent contact with the surrounding shield gasket.
3. Once the surface is clean and dry, use tweezers to remove a new pad from the shipping liner, and place it yellow-side down on the chassis.
4. Apply pressure to the pad to activate the pressure-sensitive adhesive. Remove the blue liner with tweezers.

To repair the cover pad (7585060F01) shown in the exploded view, [11.6 “XTL 5000 O5 Dash Mount Radio Exploded View” on page 11-7](#), follow the instructions for Mid Power models on page 8-42.

## 8.4 Fastener Torque Chart Notes

Table 8-4 lists the various fasteners by part number and description, followed by the torque values and the location where used. Torque all fasteners to the recommended value when assembling the radio.

Table 8-4. Fastener Torque Chart

Part Number	Description	Repair Torque (in.-lbs.)	Where Used
0310907A20	Screw, Torx M3x10	6-8	Mainboard (3), Secure Shield (2)
0385870E01	Screw, Torx M4x25	24-28	Mid Power Top Cover (10), High Power Cover (12)
0364332H02	Screw, M3x0.5x32.5	6-8	TIB (2)
0364583H01	Bolt, Shoulder, 4mm	6-8	High Power quick release
0310944A14	Screw, Plastite M3x16	6-8	Control Head, CHUC and TIB
0305760W02	Wing Screw M5x0.8x14.9	N/A	Radio Mounting (2)

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## Chapter 9 Basic Troubleshooting

### 9.1 Introduction

This chapter contains troubleshooting charts, error codes, and flexible circuit information. This section can help you isolate a problem to the board level. Board-level troubleshooting does not attempt to isolate problems to the component level. Component-level service information can be found in the *ASTRO Digital XTL 5000 Mobile Radio Detailed Service Manual*. (See the ["Related Publications"](#) section of this manual on [page xvi](#) for the specific manual number.)

**NOTE:** To access the various connector pins, use the housing eliminator/test fixture along with the diagrams found in this section of the manual. (See the section, ["Service Aids and Recommended Tools"](#) on [page 4-2](#), for the appropriate Motorola service aids and tools parts numbers.)



With the exception of some inputs on service monitors, a suitable attenuator rated at 100 W or more should always be used with all test equipment connected to the RF connector. Failure to do so can result in test equipment damage.

When performing both transmit and receive tests, it is still possible that equipment might be damaged by the radio's transmitter. This could occur under the following conditions: trunking-mode affiliation, missing emergency jumper, a defective PTT button, unintentional PTT activations, or circuit board malfunction. Therefore, an attenuator is always recommended.

### 9.2 Accessory Connectors

#### 9.2.1 J1 - Global Core Accessory Interface (GCAI)

A GCAI connector is located on the O5 control head and the transceiver interface board (TIB). The GCAI connector on the TIB contains a sub-set of the signals contained in the O5 control head GCAI connector. [Table 9-1](#) describes the function of each pin including which signals are present on the TIB GCAI connector.

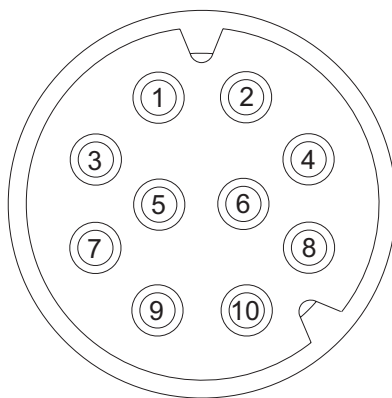


Figure 9-1. GCAI Connector

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Table 9-1. GCAI Connector Signal Descriptions

Pin	Signal Name		Description
	Control Head (J1)	TIB (J700)	
1	One-Wire	One-Wire	Signal used to identify accessory.
2	PTT	AUX_PTT	Active low Push-to-talk input. Asserting this input on the TIB results in auxiliary microphone input use (GCAI pin 7).
3	SPK	N.C.	Receive audio out designed to drive a 150Ω load.
4	USB_D-/RS232_RX	Mid-power: RS232_RX only  High-power: USB- / RS232_RX	Multiplexed USB D- and RS232 receive signal. Mid-power transceivers do not support USB at the TIB GCAI connector. The RS232 signals are CMOS levels, 0-5 volts.
5	GND	GND	Ground
6	VBUS / OPT_5V	VBUS / OPT_5V	On the control head, when the GCAI port is configured as a device, this is the VBUS input used for enumeration. When the GCAI port is configured as a host, this is the VBUS output, capable of sourcing 500mA. The TIB GCAI port can not be configured as a USB host.
7	MIC_HI	AUX_MIC	Microphone input.
8	USB_D+/RS232_TX	Mid-power: RS232_TX only  High-power: USB+ / RS232_TX	Multiplexed USB D+ and RS232 transmit signal. The interface used is based on a one-wire read of the connected accessory. Mid-power transceivers do not support USB at the TIB GCAI connector. The RS232 signals are CMOS levels, 0-5 volts.
9	HUB / KEYFAIL	KEYFAIL	Multiplexed HUB and KEYFAIL lines on the control head. The TIB only has KEYFAIL.
10	GPIO_0 / PWR_ON	GPIO_0	On the control head, this pin can be used by an accessory to turn the system on.

### 9.2.2 J2 Mid Power Transceiver - Data and Audio Rear Interface

J2 is located on the back of the transceiver. [Table 9-2](#) describes the function of each pin. The Male crimping pin can be ordered, according to the wire gauge for the accessory. Please select part number 3980034F03 for 22-28 gauge wire and 3980034F01 for 18 to 20 gauge wire.

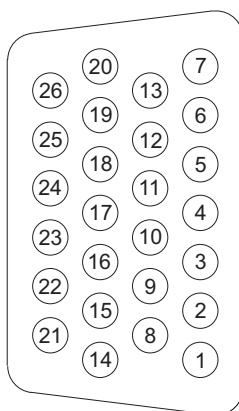


Figure 9-2. J2 Rear Accessory Connector

Table 9-2. J2 Rear Accessory Connector Signal and Voltage Descriptions

Pin	Function		Description
1	GROUND	Ground	Preferred ground for any digital lines on the rear connector.
2	BUS+	SB9600 BUS+	Part of the Motorola SB9600 communications bus to connect external devices.
3	BUS-	SB9600 BUS-	Part of the Motorola SB9600 communications bus to connect external devices.
4	DCE_TXD	RS232 Transmit Data	Part of the 4-wire RS232 interface to external data accessories, programming cables, etc. An output normally -9V no load.
5	DCE_RXD	RS232 Receive Data	Part of the 4-wire RS232 interface to external data accessories, programming cables, etc.
6	USB-	USB - Data	Part of the 2-wire USB differential data bus for future USB accessories.
7	USB+	USB + Data	Part of the 2-wire USB differential data bus for future USB accessories.
8	RESET	SB9600 RESET	Part of the Motorola SB9600 communications bus to connect external devices.
9	BUSY	SB9600 BUSY	Part of the Motorola SB9600 communications bus to connect external devices.
10	DCE_RTS	RS232 Request-To-Send	Part of the 4-wire RS232 interface to external data accessories, programming cables, etc. An output normally +9V no load.
11	DCE_CTS	RS232 Clear-To-Send	Part of the 4-wire RS232 interface to external data accessories, programming cables, etc.

Table 9-2. J2 Rear Accessory Connector Signal and Voltage Descriptions (Continued)

Pin	Function		Description
12	USB PWR	USB Power	Used for USB enumeration. Five volts is applied to this pin by the USB Host.
13	CHAN ACT	Channel Activity	0-5 volt output used for indicating detection/unsquelching of a qualified received signal. As of the release of this manual only UHF R2 is APCO compliant active low.
14	GROUND	Ground	Preferred ground for any of the analog lines on the rear connector.
15	EMERGENCY	Emergency	Input used to detect emergency activation. This pin must be connected to ground by a jumper on accessory cable if emergency is disabled, even if disabled by CPS. If enabled, this line must be grounded via a switch, which is normally closed.
16	AUX PTT*	Push To Talk	Pulling this line to ground will activate PTT function normally selecting the AUX_MIC input.
17	ONE WIRE	One-Wire data	0-2.8V bidirectional data used for identification of smart accessories/cables. Caution, an external source of voltage could damage the microprocessor.
18	VIP OUT 1	Vehicular Interface Output	High voltage open drain output used for enabling relays used for accessories such as horn/lights.
19	VIP OUT 2	Vehicular Interface Output	High voltage open drain output used for enabling relays used for accessories such as horn/lights.
20	SPKR+	Speaker +	Used along with SPKR- to connect an external speaker. The audio PA is a bridge amplifier with a 3.2-ohm minimum impedance.
21	RX FILT AUDIO	Receive Filtered Audio Out	This is a fixed level (independent of volume level) received audio signal, including alert tones. Flat or de-emphasis are programmed by CPS. Output voltage is approximately 100 mVrms per 1kHz of deviation. The DC offset is 1.4V.
22	MONITOR	Monitor overrides PL	This input is used to detect when a rear microphone accessory is taken 'off-hook', to over-ride PL to alert the user to busy traffic prior to transmitting.
23	AUX MIC	Rear microphone input	This microphone signal is independent of the microphone signal on the front microphone connector. The nominal input level is 80mVrms for 60% deviation when used for motorcycle, but can also support 300 mVrms for future APCO accessories. The DC impedance is 1560 ohms and the AC impedance is 560 ohms, 1Vrms max. 9V DC with no input load.
24	SW B+	Switched Battery Voltage	This voltage is available when the radio is switched on.
25	Ignition	Ignition Sense	Connecting this line to the ignition line of the vehicle will allow CPS ignition features such as "ignition required for turn on" to be used. Connecting this line to the car battery will defeat CPS ignition features.
26	SPKR-	Speaker -	Used along with SPKR+ to connect an external speaker. The audio PA is a bridge amplifier with a 3.2-ohm minimum impedance.

### 9.2.3 J100 CHUC - Mobile Accessory Port Interface for XTL 5000 O5 only

J100 is located on the back of the O5 control head assembly in the remote mount configuration. This connector provides pins located identical to connector J2 at the back of a mid power transceiver. Not all the pins are populated at J100 due to identical functionality on connectors J200, J400, J600, and J700. APCO audio pins can be located at J100. The VIP OUT 1 and VIP OUT 2 function at this connector when no cable is attached at J400. [Figure 9-3](#) illustrates the J100 Mobile Accessory Port (MAP) connector while [Table 9-3](#) describes the function of each pin.

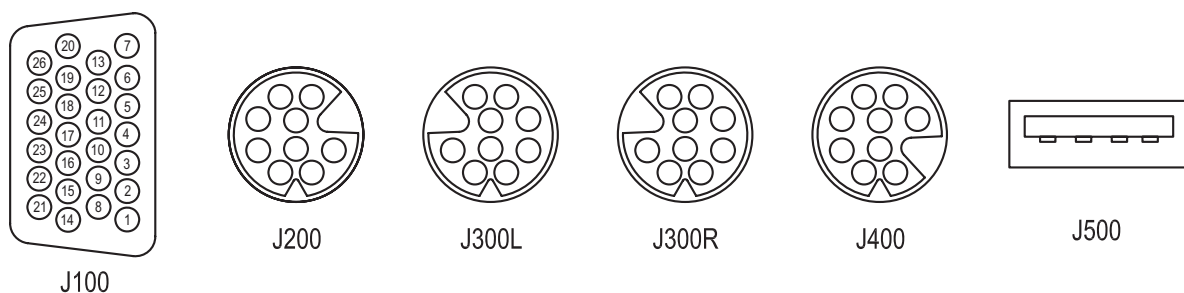


Figure 9-3. J100 Mobile Accessory Port (MAP) Connector

Table 9-3. J100 Remote Mount Control Head Mobile Accessory Port (MAP)

Pin	Function		Description
1	GND	Ground	Preferred ground for digital signals.
2	N/C	No Connect	
3	N/C	No Connect	
4	N/C	No Connect	
5	N/C	No Connect	
6	USB-	USB- Data	Part of the USB differential data bus.
7	USB+	USB+ Data	Part of the USB differential data bus.
8	N/C	No Connect	
9	N/C	No Connect	
10	N/C	No Connect	
11	N/C	No Connect	
12	VBUS	USB VBUS	Used for USB enumeration. Five volts is applied to this pin by the USB Host.
13	CHAN ACT	Channel Activity [A(p)]	Five volt active low output signal used to indicate that a qualified receive signal is present. One second after power-up, this line goes low for 1.8 seconds while the CHIB is configured. Therefore, this line should be ignored for at least 2.8 seconds after power-up. APCO required.
14	GND	Ground	Preferred ground for analog signals.
15	EMERGENCY	Emergency	Input used to detect emergency activation.
16	AUX PTT*	AUX PTT [PTT]	Pulling this line to ground will activate PTT function normally selecting the AUX_MIC input. APCO required.
17	ONE WIRE	One-Wire data	0-2.8V bidirectional data used for identification of smart accessories/cables.

Table 9-3. J100 Remote Mount Control Head Mobile Accessory Port (MAP) (Continued)

Pin	Function		Description
18	VIP OUT 1	Vehicular Interface Output	High voltage open drain output used for enabling relays used for accessories such as horn/lights.
19	VIP OUT 2	Vehicular Interface Output	High voltage open drain output used for enabling relays used for accessories such as horn/lights.
20	N/C	No Connect	
21	RX FILT AUDIO	Receive Filtered Audio Out [A(rx)]	This is a fixed level (independent of volume control setting) received audio signal, including alert tones. Flat or de-emphasis is programmed by CPS. Output voltage is approximately 100 mVrms per 1kHz of deviation. The DC offset is 1.4V. APCO required.
22	MONITOR	Monitor overrides PL	This input is used to detect when a rear microphone accessory is taken 'off-hook', to over-ride PL to alert the user to busy traffic prior to transmitting.
23	AUX MIC	Rear microphone input [A(tx)]	This microphone signal is independent of the microphone signal on the front microphone connector. The nominal input level is 80mVrms for 60% deviation when used for motorcycle, but can also support 300 mVrms for future APCO accessories. The DC impedance is 1560 ohms and the AC impedance is 560 ohms, 1Vrms max. 9V DC with no input load. APCO required.
24	SW B+	Switched Battery Voltage	This voltage is available when the radio is switched on. The voltage is supplied by the control head.
25	N/C	No Connect	
26	N/C	No Connect	

### 9.2.4 J200 CHUC - Power and Audio Interface

J200 is located on the back of the O5 control head assembly in the remote mount configuration. This connector provides the voltage into the transceiver, as well as Ignition sense and speaker lines. An alternate power cable can be used at this connector to provide Earjack audio and TX/RX record out audio. Please refer to the installation manual for ordering part numbers. [Figure 9-4](#) illustrates the J200 connector while [Table 9-4](#) describes the function of each pin.

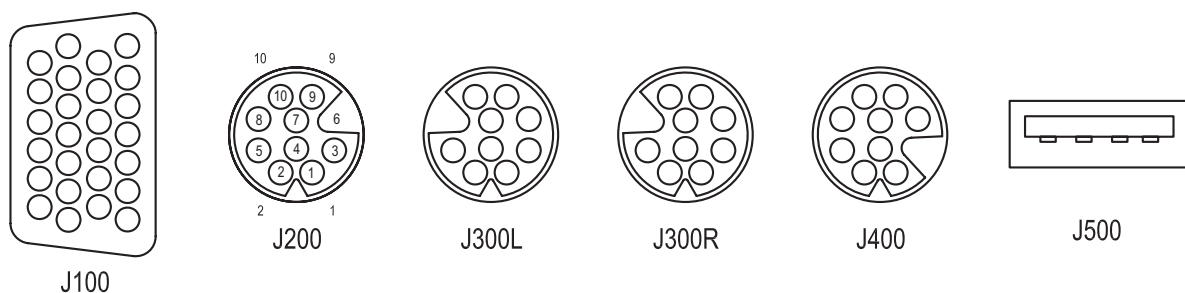


Figure 9-4. J200 Power and Audio Connector

Table 9-4. J200 Power and Audio Connector Pin Functions

Pin	Function	Description
1	SPEAKER +	Primary output for external speaker
2	SPEAKER -	Primary output for external speaker
3	Record Out	Dedicated pin at a fixed level of 300mv
4	GND (analog)	Analog ground used for Record out.
5	Earjack	Dedicated audio path with a fixed level output higher than Record out. Mutes the Audio PA when connected to an earpiece (an external speaker attached at J200 will mute upon attachment of earpiece).
6	NO PIN	
7	C.H. SPEAKER MUTE	For Headset MUTING...by turning-off audio PA in C.H. This does not MUTE the radio's rear speaker.
8	GND for Pwr	Shared for POWER and audio grounds
9	IGN (cable FUSED)	Sense line to determine the state of the vehicle's IGNITION.
10	A+ (cable FUSED)	Control Head power supply.

### 9.2.5 J300 CHUC - Controller Area Network (CAN) Interface

J300L and J300R are located on the back of the O5 control head assembly in the remote mount configuration. These two connectors are identical, in order to aid in future daisy-chaining of other CAN bus accessories. They provide the Data, digital audio, and power on/off/reset commands for the control head to transceiver communications. Please refer to the installation manual for ordering part numbers for various lengths of the CAN remote mount cables. [Figure 9-5](#) illustrates the J300 connector while [Table 9-5](#) describes the function of each pin.

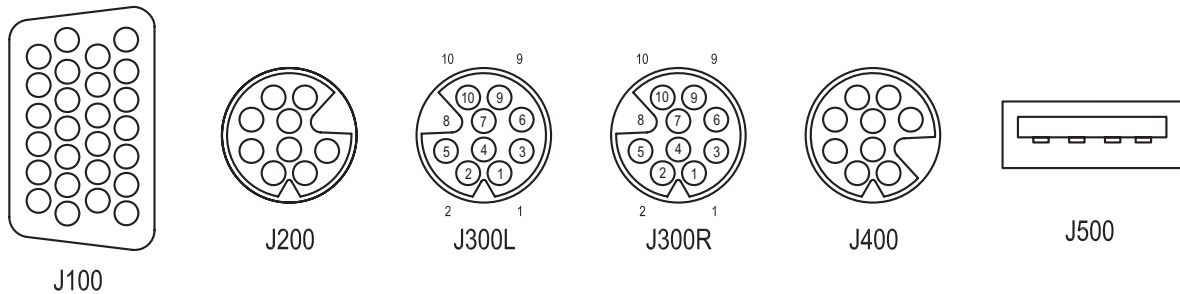


Figure 9-5. J300 Controller Area Network (CAN) Connector on CHIB

Table 9-5. J300 Controller Area Network Connector Pin Functions

Pin	Function	Description
1	CAN_1_HIGH	TX+ (AUDIO)
2	CAN_1_LOW	TX- (AUDIO)
3	CAN_3_HIGH	TX+ (PWR) <i>Dedicated for System ON/OFF/RESET commands.</i>
4	CAN termination detect pin	Pin 4 shorted to GND inside each end of the CAN cable.
5	A+	Only routed on the "03" CAN cable
6	CAN_3_LOW	TX- (PWR) <i>Dedicated for System ON/OFF/RESET commands.</i>
7	GND	Drain wire wrapped around GND shield
8	NO PIN	
9	CAN_2_HIGH	TX+ (DATA)
10	CAN_2_LOW	TX- (DATA)

## 9.2.6 J400 CHUC - VIP and DEK Interface

J400 is located on the back of the O5 control head assembly in the remote mount configuration. This connector provides the ability to utilize up to 3 VIP OUT, 3 VIP IN, the GND and SWB+ pins they require, or DEK signal lines. This connector has cable detection pins to allow the control head to determine which type of cable is being used, and therefore allow the control head to configure its pins appropriately for either VIP or DEK accessory interfacing. It is not recommend to fabricate this cable from scratch. The cable must be inserted prior to control head power-up. Please refer to the installation manual for ordering part numbers for either the VIP or DEK cable. [Figure 9-6](#) illustrates the J400 connector while [Table 9-6](#) describes the function of each pin.

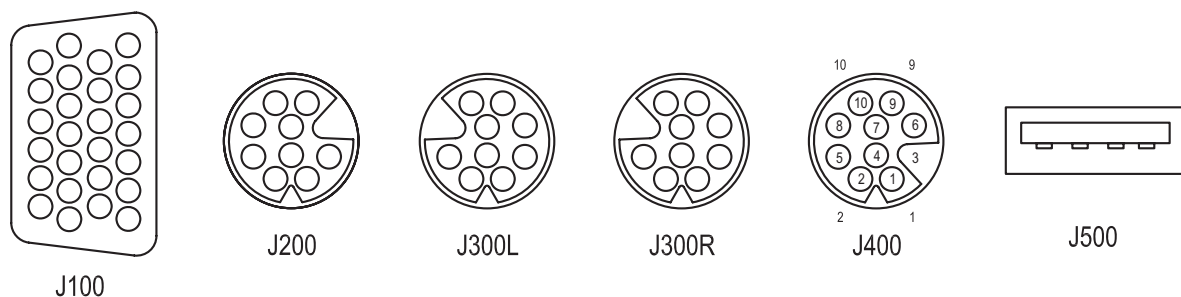


Figure 9-6. J400 VIP and DEK Connector

Table 9-6. J400 VIP and DEK Connector Functionality

Pin	No cable	DEK cable	VIP cable	Future cable	Future cable
1	SWB+	SWB+	SWB+	SWB+	SWB+
2	GND	GND	GND	GND	GND
3	no pin	no pin	no pin	no pin	no pin
4	Detect Pin 1 (Short to GND)	Detect Pin 1 (Short to GND)	Detect Pin 1 (Short to SWB+)	Detect Pin 1 (Short to GND)	Detect Pin 1 (Short to GND)
5	no pin	STROBE	VIP_OUT_1	no pin	no pin
6	no pin	DATA-OUT	VIP_OUT_2	no pin	no pin
7	no pin	CLOCK	VIP_OUT_3	no pin	no pin
8	Detect Pin 2 (Short to GND)	Detect Pin 2 (Short to SWB+)	VIP_IN_1	Detect Pin 2 (Short to GND)	Detect Pin 2 (Short to SWB+)
9	Detect Pin 3 (Short to GND)	Detect Pin 3 (Short to GND)	VIP_IN_2	Detect Pin 3 (Short to SWB+)	Detect Pin 3 (Short to SWB+)
10	no pin	DATA-IN	VIP_IN_3	no pin	no pin



### 9.2.7 J500 CHIB - USB HOST Interface

The USB host series "A" Receptacle interface interacts with USB devices through the Host Controller. It is located at the back of the CHIB. This connector supports low and full speed devices that complies with USB 2.0 standard included in the Motorola approved list.

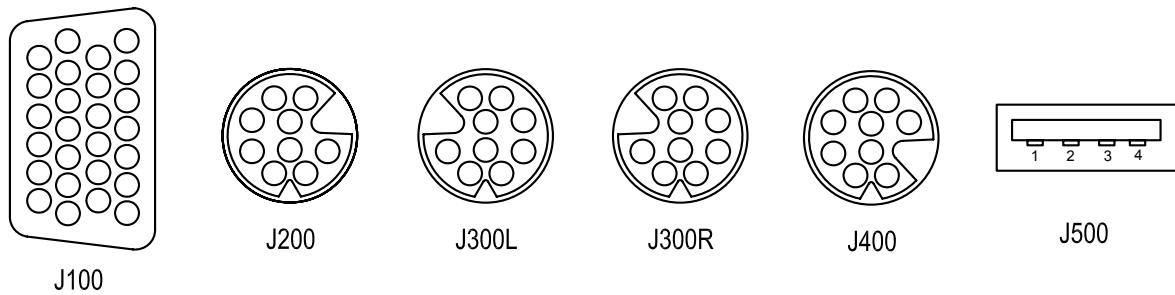


Figure 9-7. J500 USB Host Connector

Table 9-7. J500 USB Host Connector

Pin	Function	Color	Description
1	VBUS	Black	Host supplied Power to accessory
2	Data (-)	Red	Data signal
3	Data (+)	Yellow	Data signal
4	GND	Green	Bus GND return

## 9.2.8 J600 TIB - Data and Audio Interface

J600 is located on the transceiver interface board (TIB). This connector is the legacy accessory interface, but contains some additional pin functionality. [Figure 9-8](#) illustrates the J600 connector while [Table 9-8](#) describes the function of each pin.

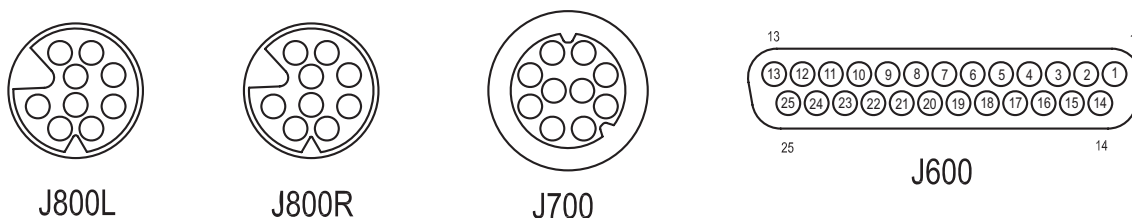


Figure 9-8. J600 Connector

Table 9-8. J600 Remote Mount Accessory Connector

Pin	Function		Description
1	AUX_PTT	Auxiliary PTT input	Pulling this line to ground will activate PTT function normally selecting AUX_MIC input. Jumpers exist on the TIB to change this pin to IGNITION or VIP_IN 1 at 3.3 volt levels.
2	DCE_TX	RS232 Transmit Data	Part of the 4-wire RS232 interface to external data accessories, programming cables, etc. An output normally -9V no load. A jumper exists on the TIB to change this pin to shield connection.
3	DCE_RX	RS232 Receive Data	Part of the 4-wire RS232 interface to external data accessories, programming cables, etc. A jumper exists on the TIB to change this pin to REMOTE IGNITION.
4	DCE_CTS	RS232 Clear-To-Send	Part of the 4-wire RS232 interface to external data accessories, programming cables, etc. Jumpers exist on the TIB to change this pin to AUX_MIC, MIC_IN, or VIPOUT_1 (passthrough). MIC_IN routes to the transceiver MIC_HI input.
5	BUS+	SB9600 BUS+	Part of the Motorola SB9600 communications bus to connect external devices. A jumper exists on the TIB to change this pin to DCE_RTS.
6	RX_AUDIO	Receive Filtered Audio Out	This is a fixed level (independent of volume level) received audio signal, including alert tones. Flat or de-emphasis are programmed by CPS. Output voltage is approximately 100 mVrms per 1kHz of deviation. The DC offset is 1.4V. Formerly called RX_Filtered_Audio.
7	AUX_RX		Formerly called RX_Audio. This pin is an input to the radio. This input is routed through the volume control circuitry to the speaker. Nominal input level is 300mVrms.
8	AUX_TX		Formerly called TX_audio. This pin is an input to the radio. This input is routed to the transmitter through multiplexed lines that are controlled by the microprocessor. Nominal input level is 300mVrms.

Table 9-8. J600 Remote Mount Accessory Connector

Pin	Function		Description
9	RX_AUDIO		This pin is the same as pin 6. A jumper exists to change this pin to VIP_IN 2 at 3.3 volt levels.
10	GND		
11	GND		
12	DAC_AUDIO_OUT		Audio spoken from the operator which goes into legacy siren and legacy VRS. Jumpers exist on the TIB to change this pin to AUX_MIC, and MIC_IN. MIC_IN routes to the transceiver MIC_HI input.
13	EMERGENCY	Emergency	Input used to detect emergency activation. To use this input, a shorting jumper on the TIB, which grounds this input, must be removed. Once the jumper is removed, emergency operation is possible at either this connector or at the J2 connector.
14	BUS-	SB9600 BUS-	Part of the Motorola SB9600 communications bus to connect external devices.
15	AUX_MIC VIPOUT_1	Auxiliary microphone input Vehicle Interface Port 1	HLN1454B has AUX_MIC as the default state of this pin. HLN1454C has VIPOUT_1 as the default state of this pin. The nominal input level for AUX_MIC is 80 mVrms for 60% deviation when used for motorcycle, but can also support 300 mVrms for future APCO accessories. The DC impedance is 1560 ohms and the AC impedance is 560 ohms, 1 Vrms max 9V DC with no input load. Jumpers exist on the TIB to change this pin to MIC_IN, DAC_AUDIO_OUT, and VIPOUT_1 (passthrough). MIC_IN routes to the transceiver MIC_HI input.
16	REMOTE IGNITION	Ignition Sense independent of rear J2 IGNITION pin	Connecting this line to the vehicle ignition will allow CPS ignition features such as "ignition required for turn on" to be used. Connecting this line to the car battery will defeat CPS ignition features.
17	DCE_RTS	RS232 Request-To-Send	Part of the 4-wire RS232 interface to external data accessories, programming cables, etc. An output normally +9V no load. A jumper exists on the TIB to change this pin to VIPOUT_2 (passthrough).
18	GND	Ground	
19	RESET	SB9600 RESET	Part of the Motorola SB9600 communications bus to connect external devices.
20	A+	Battery Voltage	
21	GND	Ground	
22	SWB+	Switched Battery Voltage	This voltage is available when the radio is switched on.
23	BUSY	SB9600 BUSY	Part of the Motorola SB9600 communications bus to connect external devices.
24	SPKR-	Speaker-	Used along with SPKR+ to connect an external speaker. The audio PA is a bridge amplifier with a 3.2-ohm minimum impedance.
25	SPKR+	Speaker+	Used along with SPKR- to connect an external speaker. The audio PA is a bridge amplifier with a 3.2-ohm minimum impedance.

### 9.2.9 J700 TIB - Global Core Accessory Interface (GCAI) Interface

J700 is located on the transceiver interface board (TIB) used in the remote mount configuration. This connector is the GCAI connector. Only pins with the purpose of data re-programming or data communications have been placed at this connector.

**NOTE:** the USB GCAI cable is not functional with the TIB GCAI when a mid power transceiver is attached, because the USB lines are only at the front of a high power transceiver.

**NOTE:** the same TIB is used for both mid power and high power transceivers. [Figure 9-9](#) illustrates the J700 connector while [Table 9-1](#) describes the function of each pin.

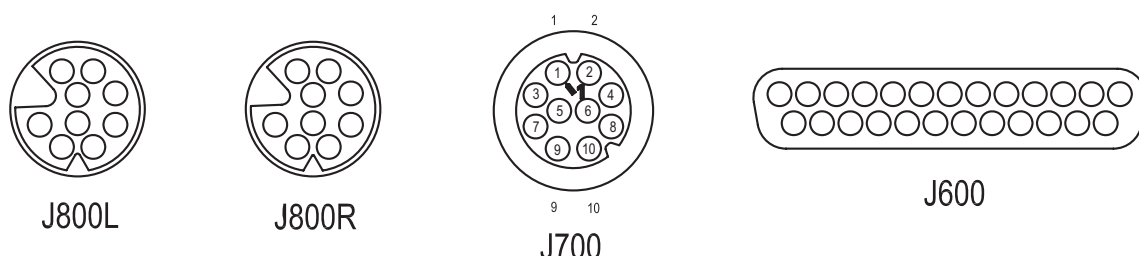


Figure 9-9. J700 GCAI Programming Connector

### 9.2.10 J800 TIB - Controller Area Network (CAN) Interface

J800L and J800R are located on the transceiver interface board (TIB). These two connectors are identical, in order to aid in future daisy-chaining of other CAN bus accessories. They provide the Data, digital audio, and power on/off/reset commands for the control head to transceiver communications. Please refer to the installation manual for ordering part numbers for various lengths of the CAN remote mount cables. [Figure 9-10](#) illustrates the J800 connector while [Table 9-9](#) describes the function of each pin.

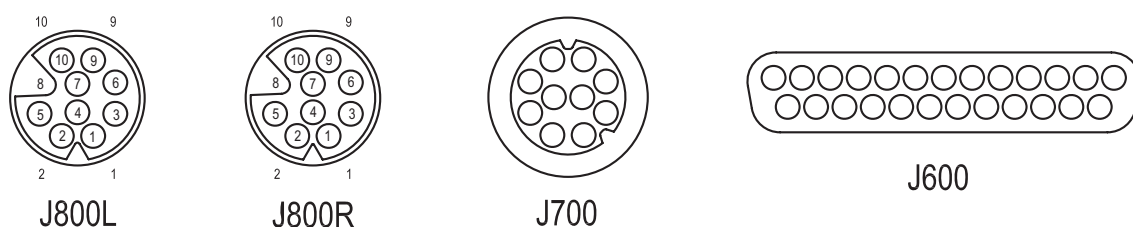


Figure 9-10. J800 Controller Area Network (CAN) Connector on TIB

Table 9-9. J800 Controller Area Network Connector Pin Functions

Pin	Function	Description
1	CAN_1_HIGH	TX+ (AUDIO)
2	CAN_1_LOW	TX- (AUDIO)
3	CAN_3_HIGH	TX+ (PWR) Dedicated for System ON/OFF/RESET commands.

Table 9-9. J800 Controller Area Network Connector Pin Functions

Pin	Function	Description
4	CAN termination detect pin	Pin 4 shorted to GND inside each end of the CAN cable.
5	A+	Only routed on the "03" CAN cable
6	CAN_3_LOW	TX- (PWR) <i>Dedicated for System ON/OFF/RESET commands.</i>
7	GND	Drain wire wrapped around GND shield
8	NO PIN	
9	CAN_2_HIGH	TX+ (DATA)
10	CAN_2_LOW	TX- (DATA)

### 9.2.11 I/O Disclaimer

Some of the signal lines on the J2 accessory connector are limited to between 0 and 5-volt operation while other inputs are limited to between 0 and 20 volts. The exception is four-wire RS232, which can tolerate up to  $\pm 15$  V maximum. At no time should any two (or more) outputs be connected together. Exceeding the input voltages or output loads listed in the above tables could result in electronic component failure. In most cases Zener diodes have been added to protect against ESD.

### 9.2.12 RS232 Connector Naming Scheme

Figure 9-11 illustrates the differences between the XTL 5000 radio connector computer data and control signal names as these signals pass from one connector to another.

REAR CONNECTOR naming schemes						Connecting to a computer = DTE device:	
Radio pin direction	J2 pin number	J2 pin name	"pin alternate name"	EIA compatible name at REAR connector = J2	P2 rear accessory cable DB9 (Female) = "DCE" interface	DB9 (Male) serial port connector = "DTE" interface	Data device pin direction
output	J2-4	UARTA_TX	no change	TX_DCE	TX_DCE = pin 2	<--> pin 2 = RX_DTE	input
input	J2-5	UARTA_RX	no change	RX_DCE	RX_DCE = pin 3	<--> pin 3 = TX_DTE	output
output	J2-10	UARTA_CTS	becomes RTS	RTS_DCE	RTS_DCE = pin 8	<--> pin 8 = CTS_DTE	input
input	J2-11	UARTA_RTS	becomes CTS	CTS_DCE	CTS_DCE = pin 7	<--> pin 7 = RTS_DTE	output

**NOTE:** TX to RX and RTS to CTS

Figure 9-11. RS232 Connector Naming Scheme

## 9.3 Microphone Bias

A 9 volt DC microphone bias is present on the MIC\_IN line. When this line is loaded by the microphone electronics, as when the PTT button is pressed, the bias voltage drops to between 3 and 6 volts. The MIC\_IN line has an AC input impedance of 560 ohms. The MIC\_IN line should not be loaded such that the bias voltage drops below 1 volt or rises above 10.5 volts. If the bias voltage falls outside this range, the signal will be clipped by clamping diodes designed to protect the input. When testing with a signal generator or other audio source, use a DC blocking capacitor of 10 $\mu$ F on the MIC\_IN line. If the capacitor is polarized, then the plus lead goes to the radio MIC\_IN line. If the signal generator has the option of a DC offset, then applying a DC offset of 2.5 volts may be used instead of the capacitor. MIC\_IN refers to both MIC\_HI and AUX\_MIC.

## 9.4 Audio PA Out Bias

The audio PA is a BTL (bridge-to-load) amplifier. When the radio is in receiver mode, the output of both speaker leads bias up to half of the supply voltage. Considering that both leads are at the same potential, the average DC voltage across the load is zero. At maximum volume the signal voltage to the load is double that of one amplifier peak-to-peak because the amplifiers work together 180 degrees out of phase. Caution must be taken not to short either lead to ground, which might cause component damage. Even though audio may still be heard from the speaker, the shorted side will go into current limiting and eventually into thermal shutdown, shutting off the amplifier. These protection devices are not intended to be tested.

## 9.5 Replacement Board Procedures

Once a problem has been isolated to a specific board, use one of the following recommended repair procedures:

- Install a good board from your inventory into the radio.
- Order a replacement board from Radio Products Services Division at 1-800-422-4210. Refer to [“Appendix A Replacement Parts Ordering” on page A-1](#) for further information.
- Troubleshoot the defective board using the *ASTRO XTL 5000 Digital Mobile Radios Detailed Service Manual*. (Refer to the [“Related Publications”](#) section of this manual on [page xvi](#) for the specific manual number.)

## 9.6 Power-Up Error Codes

When the radio is turned on (power-up), the radio performs cursory tests to determine if its basic electronics and software are in working order. Problems detected during these tests are presented as error codes on the radio's display. The presence of an error should prompt the user that a problem exists and that a service technician should be contacted.

Self-test errors are classified as either fatal or non-fatal. Fatal errors inhibit user operation; non-fatal errors do not. Use the following tables to aid in understanding particular power-up error code displays.

*Table 9-10. Power-Up Error Codes*

Error Code	Description	Error Type	Corrective Action
ERROR 01/02	FLASH ROM Codeplug Checksum	NON-FATAL	Reprogram the codeplug.
ERROR 01/12	Security Partition Checksum	NON-FATAL	Reprogram the security partition.
ERROR 01/22	Tuning Codeplug Checksum	NON-FATAL	Reprogram the tuning partition.
FAIL 01/81	FLASH ROM Checksum	FATAL	Reprogram the radio firmware.
FAIL 01/82	FLASH ROM Codeplug Checksum	FATAL	Reprogram the codeplug.
FAIL 01/88	External SRAM Failure	FATAL	Turn the radio off, then on.
FAIL 01/90	General Hardware	FATAL	Turn the radio off, then on.
FAIL 01/92	Security Partition Checksum	FATAL	Reprogram the security partition.
FAIL 01/93	FlashPORT AUTHENT CODE Failure	FATAL	Contact the depot.
FAIL 01/98	Internal RAM Failure	FATAL	Turn the radio off, then on.
FAIL 01/A2	Tuning Codeplug Checksum	FATAL	Reprogram the tuning partition.
FAIL 02/81	DSP ROM Checksum	FATAL	Reprogram the DSP firmware.
FAIL 02/88	DSP RAM Fatal Error	FATAL	Turn the radio off, then on.
FAIL 02/90	General DSP Hardware Failure	FATAL	Turn the radio off, then on.
ERROR 05/10	Control Head Hardware Error	NON-FATAL	Turn the radio off, then on.
FAIL 05/81	Control Head ROM Checksum Error	FATAL	Replace the control head.
ERROR 06/10	Aux Control Head Hardware Error	NON-FATAL	Turn the radio off, then on.
FAIL 06/81	Aux Control Head ROM Checksum Error	FATAL	Replace the aux. control head.
ERROR 08/10	Siren Hardware Error	NON-FATAL	Turn the radio off, then on.
FAIL 08/81	Siren ROM Checksum Error	FATAL	Replace the siren.

Table 9-10. Power-Up Error Codes (Continued)

Error Code	Description	Error Type	Corrective Action
ERROR 09/10	Secure Hardware Error	NON-FATAL	Ensure secure shield is screwed to chassis and making contact with secure module. Otherwise, replace the secure module and/or secure interconnect board.
FAIL 09/90	Secure Hardware Fatal Error	FATAL	Replace the secure module.
ERROR 12/10	VRS Hardware Error	NON-FATAL	Turn the radio off, then on.
FAIL 12/81	VRS ROM Checksum Error	FATAL	Replace the VRS.
ERROR 1C/10	TRC Hardware Error	NON-FATAL	Turn the radio off, then on.
FAIL 1C/81	TRC ROM Checksum Error	FATAL	Replace the TRC.
FL 01/AO	Back-end receiver Failure	FATAL	Turn the radio off, then on.
FL 02/CO	Wrong microprocessor	FATAL	Send the radio to the depot; replace the daughter card.
CH MISMATCH	Control Head hardware does not match codeplug.	FATAL	Replace control head with type that matches codeplug.
No EMERG PWRUP	Emergency Powerup (via footswitch) is enabled in the codeplug, but the radio hardware does not support this feature.	NON-FATAL	Disable Emergency Powerup feature in the CPS.
FL 05/81	Firmware Checksum Error	FATAL	Contact the Depot
FL 05/82	Invalid CH PSDT	FATAL	Contact the Depot
FL 05/92	FPGA Image not located in PSDT	FATAL	Contact the Depot
FL 05/93	FPGA Init failure	FATAL	Contact the Depot
VRS001	VRS Frequency Band in the mobile codeplug does not match VRS hardware	NON-FATAL	Reprogram VRS personality codeplug setting with correct value.

## 9.7 Operational Error Codes

During radio operation, the radio performs dynamic tests to determine if the radio is working properly. Problems detected during these tests are presented as error codes on the radio's display. The presence of an error code should prompt a user that a problem exists and that a service technician should be contacted. Use [Table 9-11](#) to aid in understanding particular operational error codes.

Table 9-11. Operational Error Codes

Error Code	Description	Error Type	Corrective Action
FAIL 001	Synthesizer Out-of-Lock	NON-FATAL	1. Reprogram the codeplug. 2. Refer to Detailed Service Manual.
FAIL 002	Personality checksum or system block error	NON-FATAL	Reprogram the codeplug.



## 9.8 Transmitter Troubleshooting

Table 9-12 can help you troubleshoot problems that might occur in the transmitter section of your radio.

Table 9-12. Transmitter Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
No RF Power Output	TX Power Level Programming	Check TX power level programming (from the appropriate Customer Programming Software).
	Radio Transceiver	Refer to the Detailed Service Manual.
Distorted Modulation	Bandwidth	Is the correct bandwidth selected (use the appropriate Customer programming software)? Is radio properly tuned? (See <a href="#">Chapter 6: Radio Alignment Procedures</a> .)
	Compensation Not Set/ Working (DPL Distorted)	Check the compensation setting. If compensation won't adjust, go to "Can't Set Compensation" below.
	Radio Transceiver	Refer to the Detailed Service Manual.
No Modulation, Bad Microphone Sensitivity	Check Deviation and Compensation	Retune, if necessary. (See <a href="#">Chapter 6: Radio Alignment Procedures</a> .)
	Microphone	Speak loudly into the microphone while monitoring the microphone line (pin 4 of J0401 in dash configuration, pin 7 of GCAI in remote configuration). If it is not greater than 80 mVrms, then check the microphone. In the dash configuration check the flex as well. If the microphone line is greater than 80mVrms refer to the Detailed Service Manual.
No/Low Signaling (PL, DPL, Trunking, MDC)	Check Programming	Reprogram the codeplug.
Can't Set Compensation	Deviation and Compensation	Vary deviation and compensation controls from maximum to minimum using softpots in the TX Deviation Balance screen and TX Deviation Limit screen (using the appropriate radio-programming software—see <a href="#">Chapter 6: Radio Alignment Procedures</a> ).
	Radio Transceiver	Refer to the Detailed Service Manual.

**NOTE:** "AC-coupled" is adding a 10 µf capacitor externally to prevent biasing on the MIC-HI line from being grounded.

## 9.9 Receiver Troubleshooting

Table 9-13 can help you troubleshoot problems that might occur in the receiver section of your radio.

Table 9-13. Receiver Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
Radio does not power-up	Blown power fuse	Check the fuse in the red cable.
	Blown ignition fuse	Check the fuse in the ignition cable, yellow cable from CHIB, red cable from transceiver J2 connection. Note that the IGNITION field in the codeplug would need to be set to REQUIRED for the ignition fuse to affect powerup. If IGNITION is set to anything besides REQUIRED, then ignore this step.
	Control Head	When the power button is pressed the control head should draw at least 100mA. If not, refer to the detailed service manual for control head troubleshooting. In addition, if the control head powers-up then powers-down roughly 8 seconds later, the control head has failed.
	Radio Transceiver	Measure SW_B+ on J2 pin 24. SW_B+ should go to battery voltage when the power button is pressed. If SW_B+ is high, then refer to the detailed service manual for radio transceiver troubleshooting.
	Control head / TIB to transceiver FLEX	If SW_B+ is not present on J2 pin 24, then the flex is suspect. Replace the flex. If SW_B+ is still not present, refer to the detailed service manual for ON/OFF system troubleshooting.
	CAN Cable	Ensure that the CAN cable is connected in remote systems.
Radio will not power-down	Emergency Switch	Check the emergency signal at J0401-18. A high voltage may indicate that the emergency switch line is not grounded by the rear accessory cable.
	Radio Transceiver	Measure SW_B+ on J2 pin 24. SW_B+ should drop to zero sometime after the power button is pressed. If SW_B+ is low, then refer to the detailed service manual for radio transceiver troubleshooting. If SW_B+ remains high, refer to the detailed service manual for ON/OFF system troubleshooting.
No Receiver Audio or Receive Does Not Unsquench	Code Plug	Check the codeplug to ensure correct frequency and signaling (PL, DPL) is enabled (use the appropriate radio-programming software).
	Speaker	Check for speaker leads shorted to ground or open speaker wires. Replace, if necessary.
	Radio Transceiver	Refer to the Detailed Service Manual.
Audio Distorted or Not Loud Enough	Codeplug	Ensure the codeplug is properly configured, including bandwidth and signaling.
	Synthesizer Not On Frequency/Working	See "Reference Oscillator Alignment" on page 6-8.
	Radio Transceiver	Refer to the Detailed Service Manual.

Table 9-13. Receiver Troubleshooting Chart (Continued)

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
RF Sensitivity Poor	Synthesizer Not On Frequency/Working	Check the local oscillator frequency. <a href="#">See "Reference Oscillator Alignment" on page 6-8.</a>
	Radio Transceiver	Refer to the Detailed Service Manual.
Radio Will Not Squelch	Codeplug	Check the offending channel for spurious activity by monitoring with a known-good radio or service monitor. If possible, remove the offending source (computer, etc.). If not, increase the squelch level using the appropriate radio-programming software.
Excessive Noise in Fading Conditions	Check Programming for Correct Bandwidth	Reprogram the codeplug with the correct bandwidth.

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# Chapter 10 Functional Block Diagrams and Connectors

This chapter contains the ASTRO XTL 5000 digital mobile radio functional block diagrams and connector locations.

Table 10-1. Table of Functional Block Diagrams and Connectors

Page	Figure Name
10-2	Figure 10-1. XTL 5000 Transceiver Functional Block Diagram
10-3	Figure 10-2. XTL 5000 O3 Dash and Remote Control Head Functional Block Diagram
10-4	Figure 10-3. XTL 5000 O5 Dash and Remote Control Head Functional Block Diagram
10-5	Figure 10-4. XTL 5000 O3 Control Head Functional Block Diagram
10-6	Figure 10-5. XTL 5000 O5 Control Head Functional Block Diagram
10-7	Figure 10-6. XTL 5000 O5 Control Head Interface Board (CHIB) Functional Block Diagram
10-7	Figure 10-7. XTL 5000 Transceiver Interface Board (TIB) Functional Block Diagram
10-8	Figure 10-8. O3 Dash-Mount Radio Connector Locations (Mid Power Only)
10-8	Figure 10-9. O3 Remote-Mount Radio Connector Locations
10-8	Figure 10-10. O3 Remote-Mount Radio Connector Locations (High Power Only)
10-9	Figure 10-11. O5 Dash-Mount Radio Connector Locations (Mid Power Only)
10-9	Figure 10-12. O5 Remote-Mount Radio Connector Locations (Mid Power Only)
10-9	Figure 10-13. O5 Remote-Mount Radio Connector Locations (High Power Only)
10-10	Figure 10-14. Main Board Connector Locations - Side 1 (Mid Power Only)
10-10	Figure 10-15. Main Board Connector Locations - Side 2 (Mid Power Only)
10-10	Figure 10-16. Main Board Connector Locations - Side 1 (High Power Only)
10-10	Figure 10-17. Main Board Connector Locations - Side 2 (High Power Only)
10-11	Figure 10-18. Control Head 50-pin Connector
10-11	Figure 10-19. Control Head 60-pin Connector

10.1 XTL 5000 Transceiver Functional Block Diagram

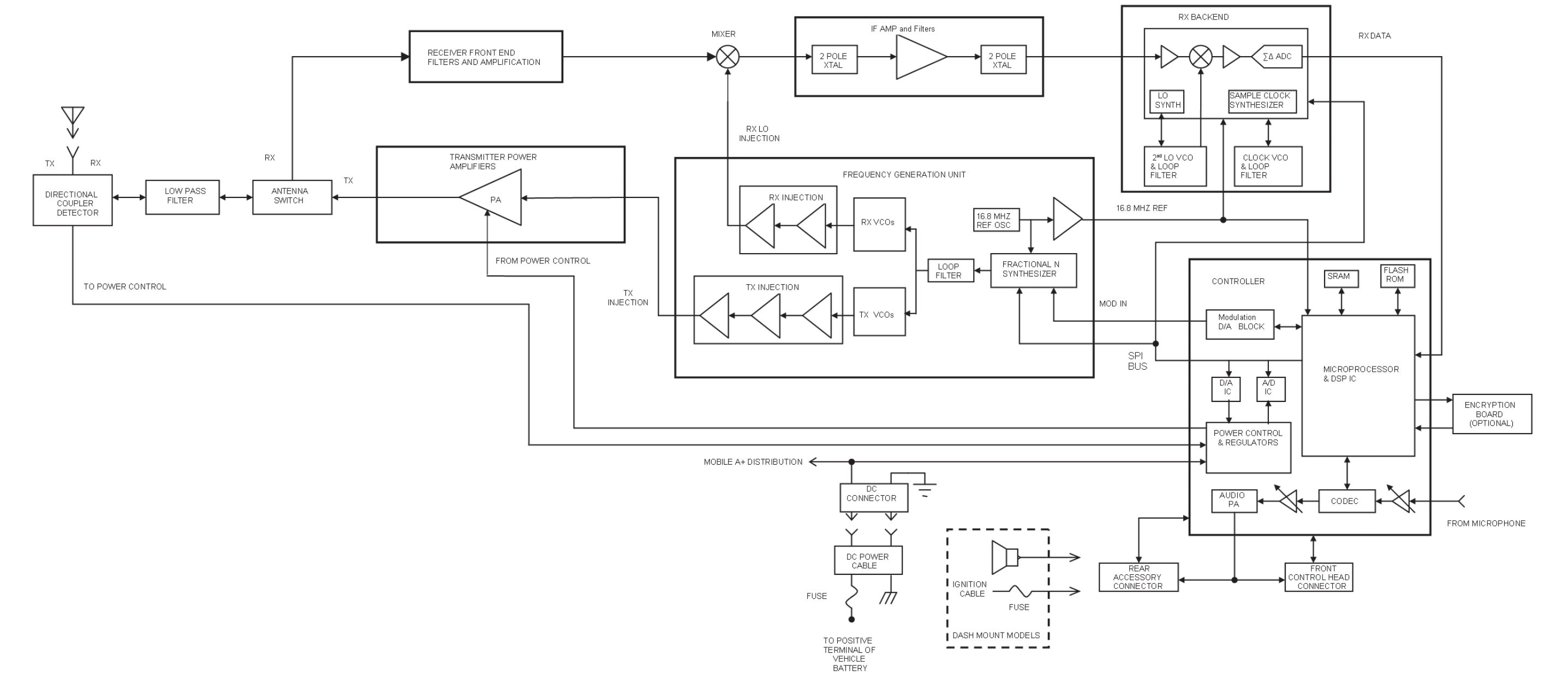


Figure 10-1. XTL 5000 Transceiver Functional Block Diagram

10.2 XTL 5000 O3 Dash and Remote Control Head Functional Block Diagram

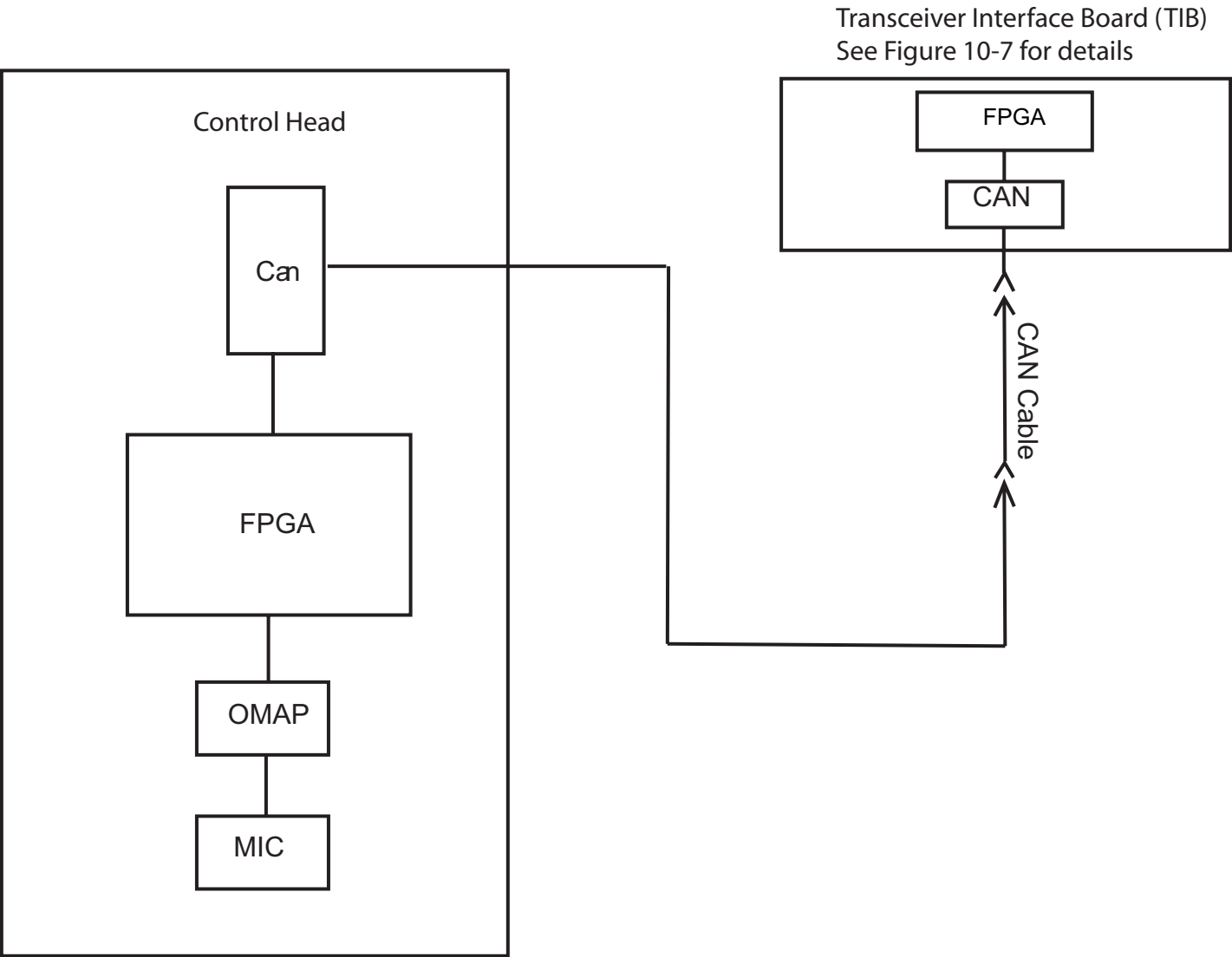


Figure 10-2. XTL 5000 O3 Dash and Remote Control Head Functional Block Diagram

10.3 XTL 5000 O5 Dash and Remote Control Head Functional Block Diagram

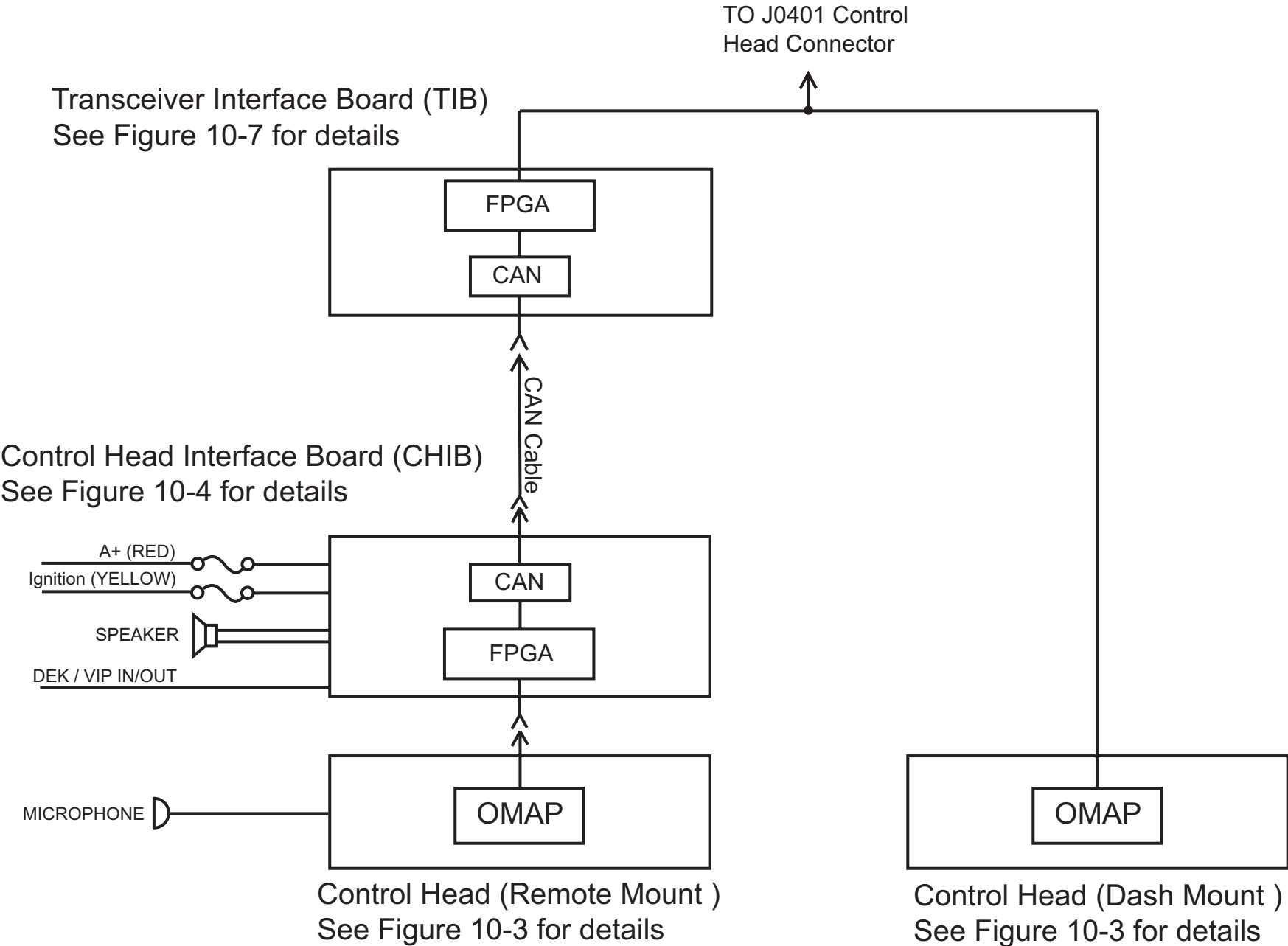


Figure 10-3. XTL 5000 O5 Dash and Remote Control Head Functional Block Diagram

10.4 XTL 5000 O3 Control Head Functional Block Diagram

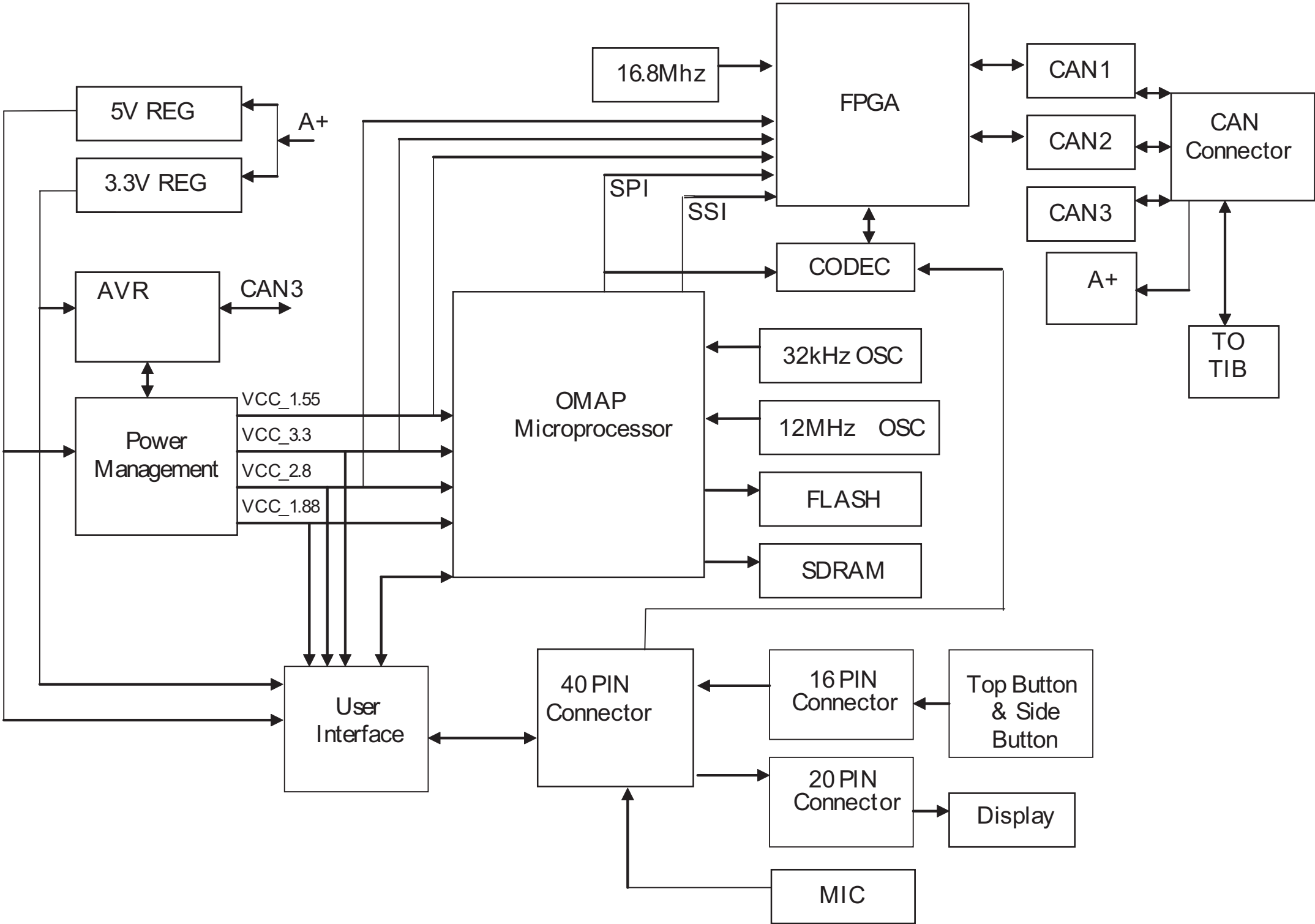


Figure 10-4. XTL 5000 O3 Control Head Functional Block Diagram



10.5 XTL 5000 O5 Control Head Functional Block Diagram

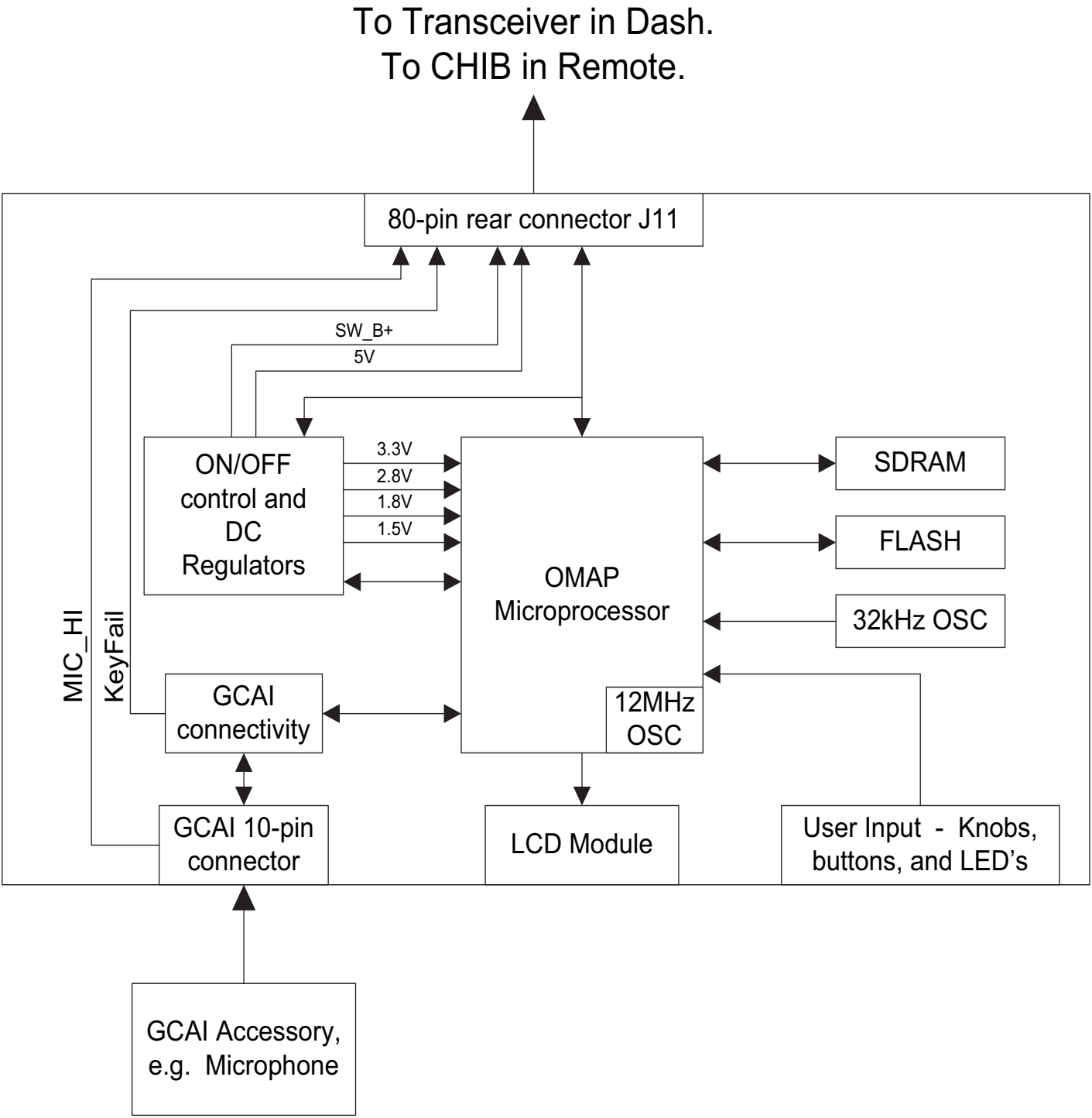


Figure 10-5. XTL 5000 O5 Control Head Functional Block Diagram

10.6 XTL 5000 O5 Control Head Interface Board (CHIB) Functional Block Diagram

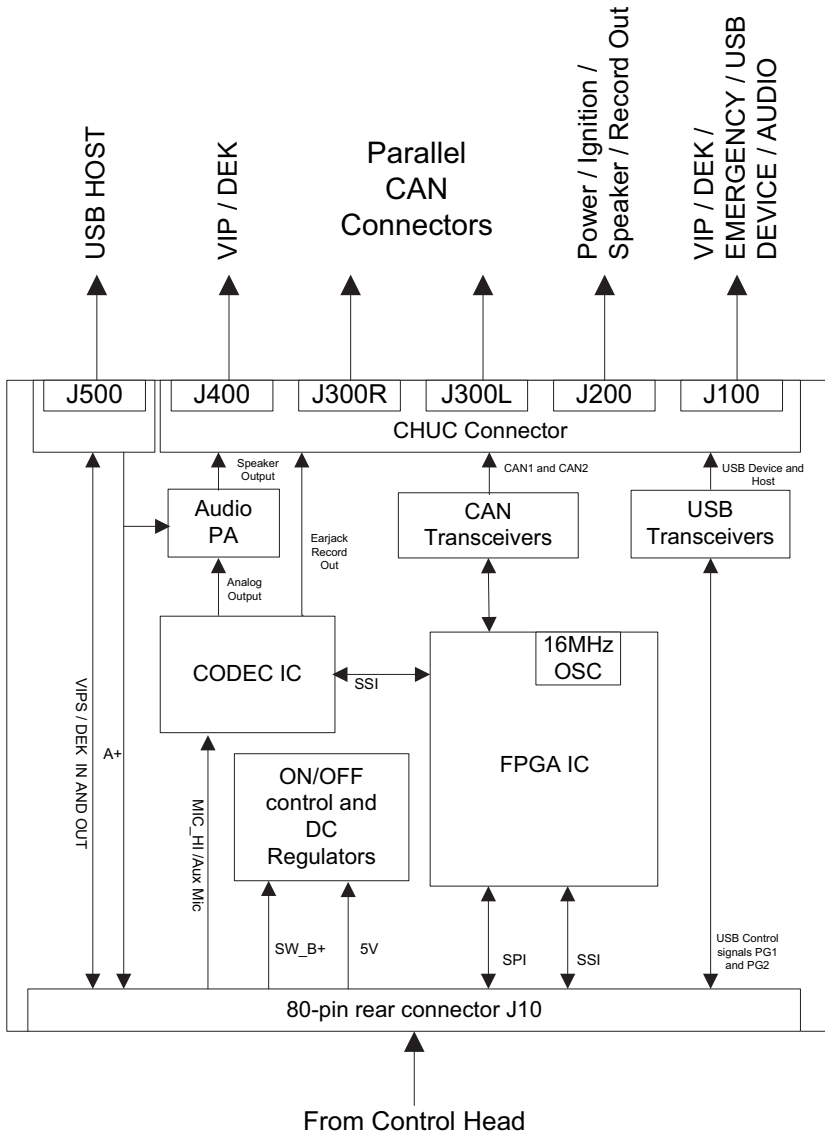


Figure 10-6. XTL 5000 O5 Control Head Interface Board (CHIB) Functional Block Diagram

10.7 XTL 5000 Transceiver Interface Board (TIB) Functional Block Diagram

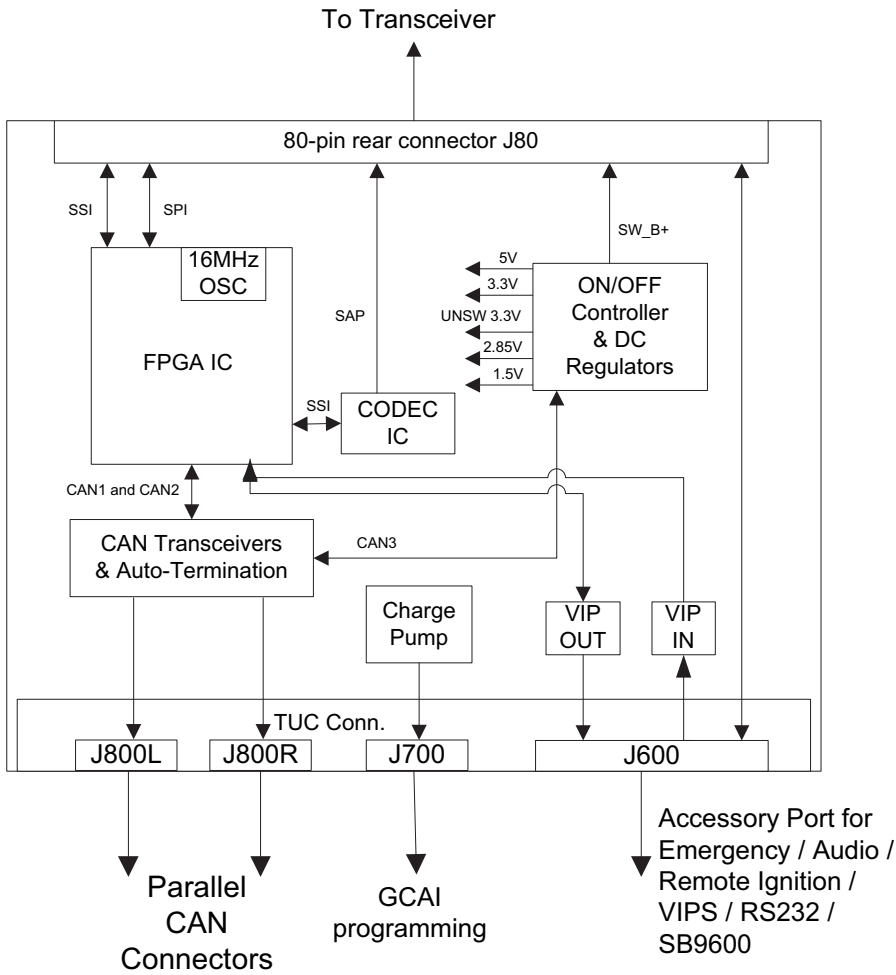


Figure 10-7. XTL 5000 Transceiver Interface Board (TIB) Functional Block Diagram

10.8 XTL 5000 O3 Radio Connector Locations

10.8.1 Mid Power Only

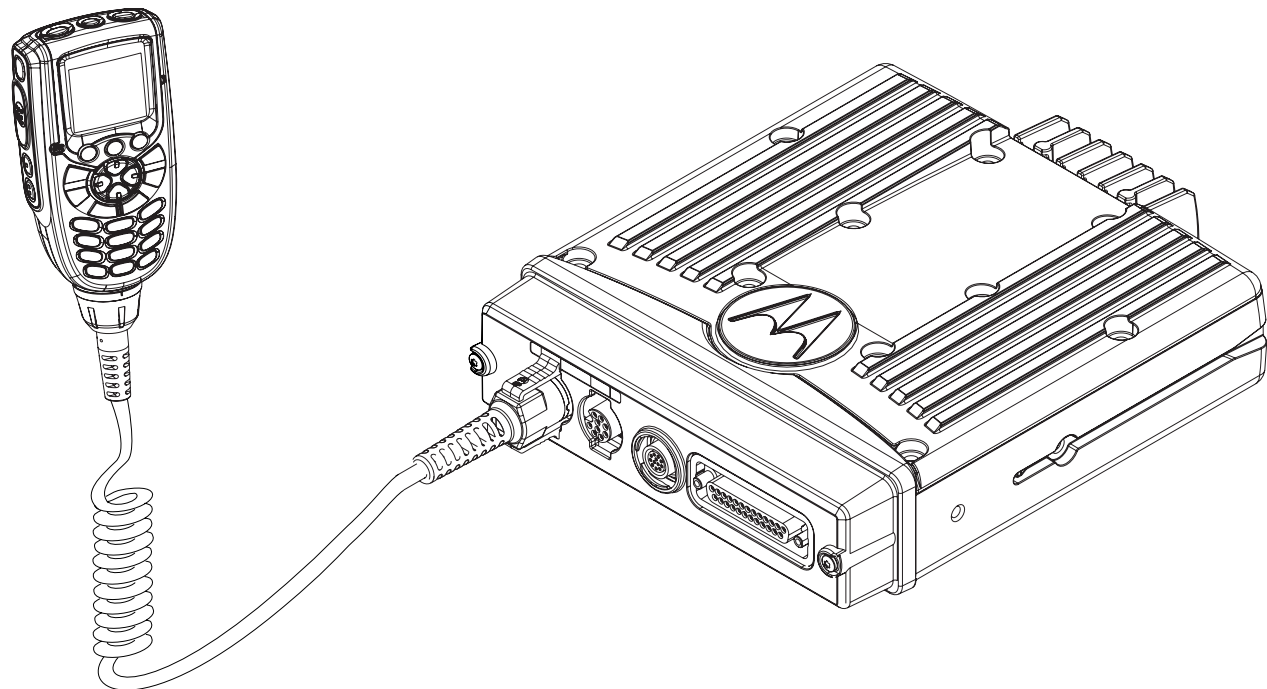


Figure 10-8. O3 Dash-Mount Radio Connector Locations (Mid Power Only)

10.8.2 High Power Only

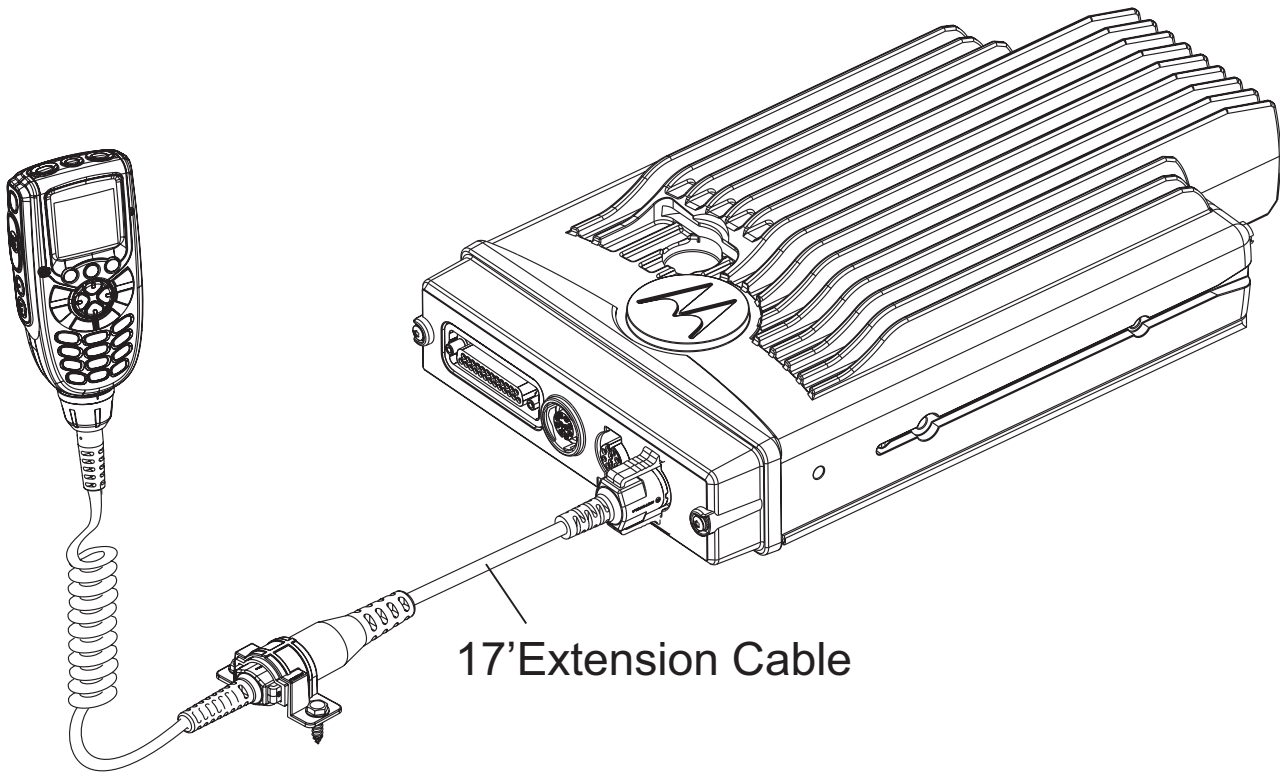


Figure 10-10. O3 Remote-Mount Radio Connector Locations (High Power Only)

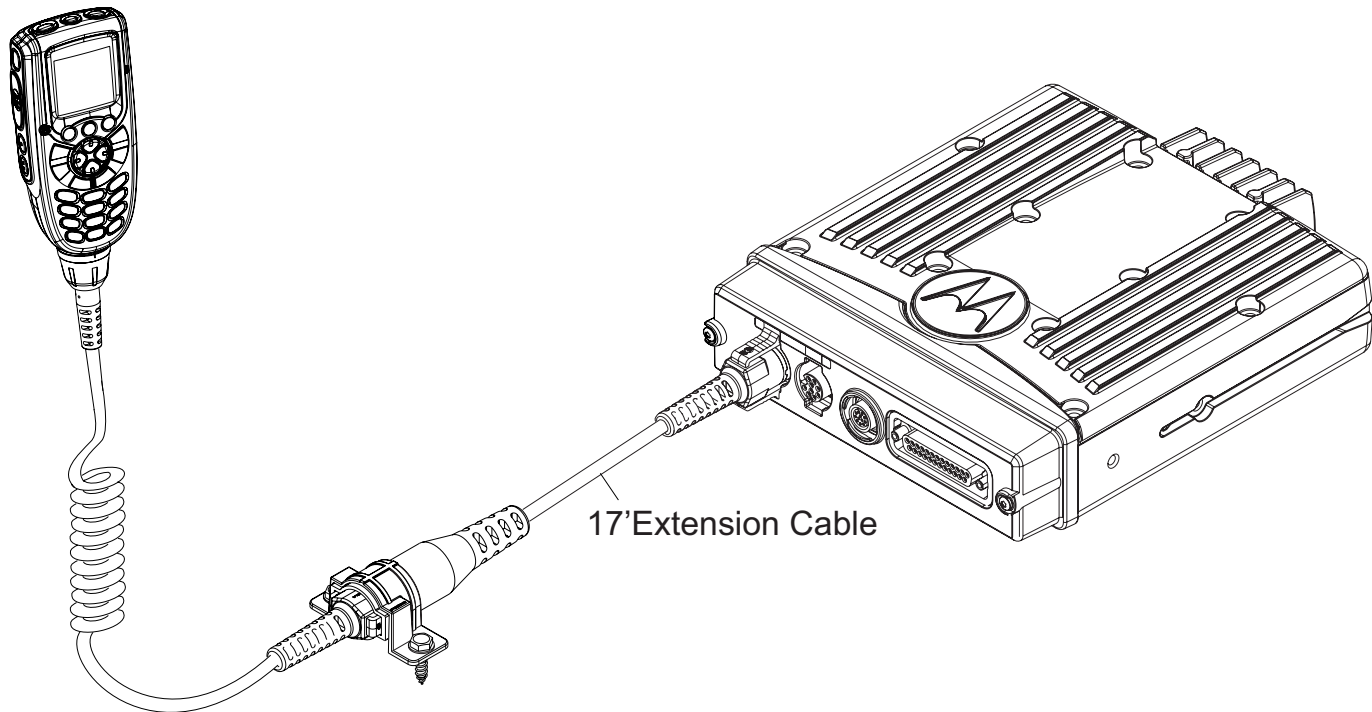


Figure 10-9. O3 Remote-Mount Radio Connector Locations

10.9 XTL 5000 O5 Radio Connector Locations

10.9.1 Mid Power Only

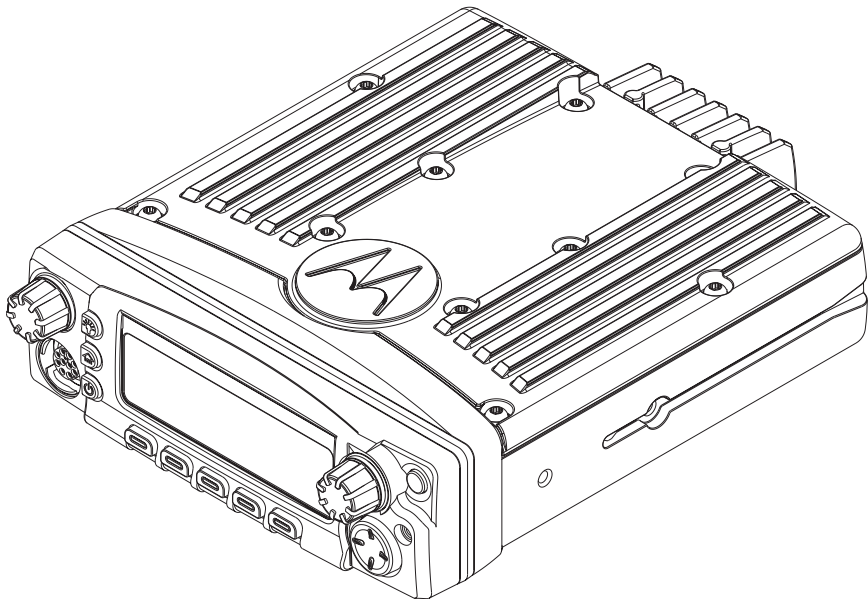


Figure 10-11. O5 Dash-Mount Radio Connector Locations (Mid Power Only)

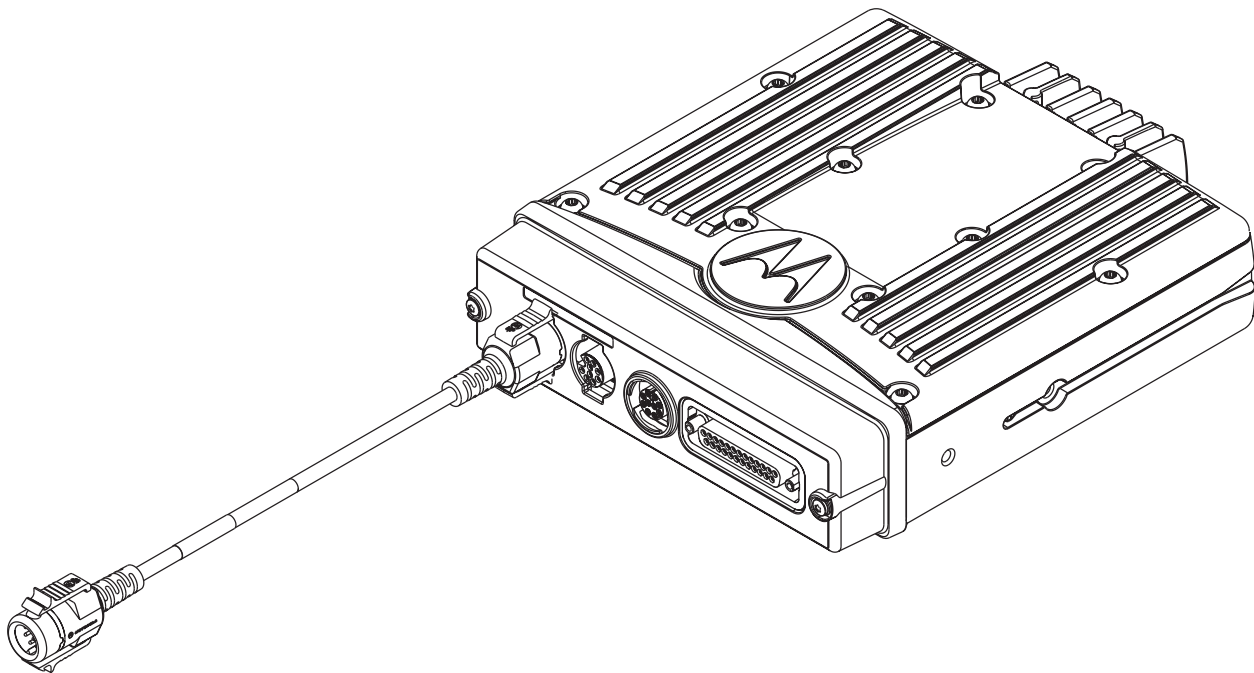


Figure 10-12. O5 Remote-Mount Radio Connector Locations (Mid Power Only)

10.9.2 High Power Only

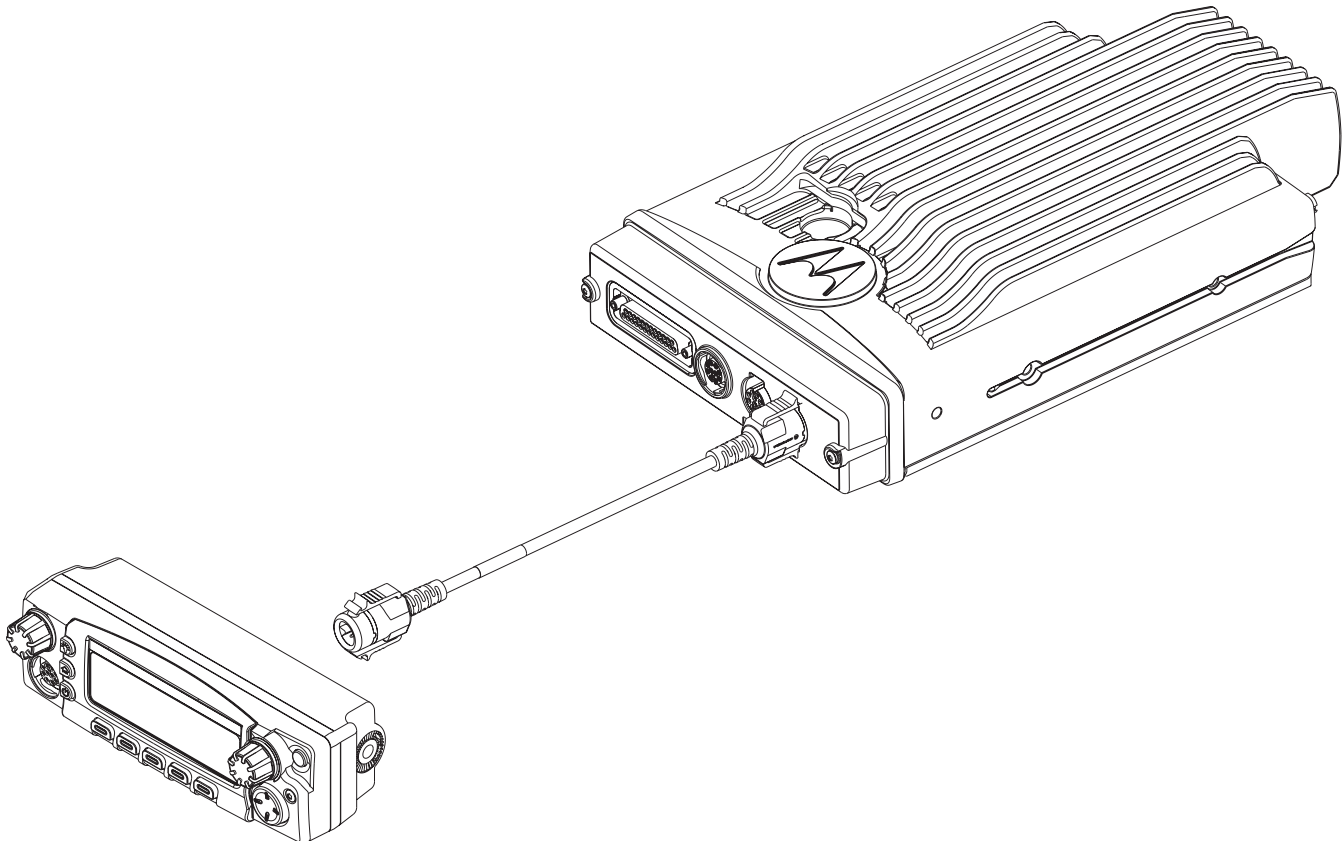


Figure 10-13. O5 Remote-Mount Radio Connector Locations (High Power Only)

10.10 Board Level Connector Locations

10.10.1Mid Power Only

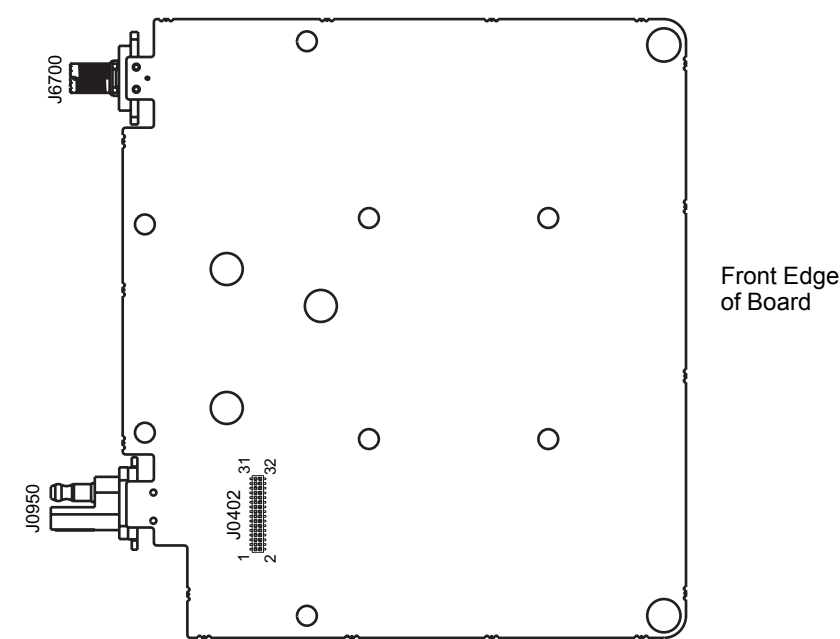


Figure 10-14. Main Board Connector Locations - Side 1 (Mid Power Only)

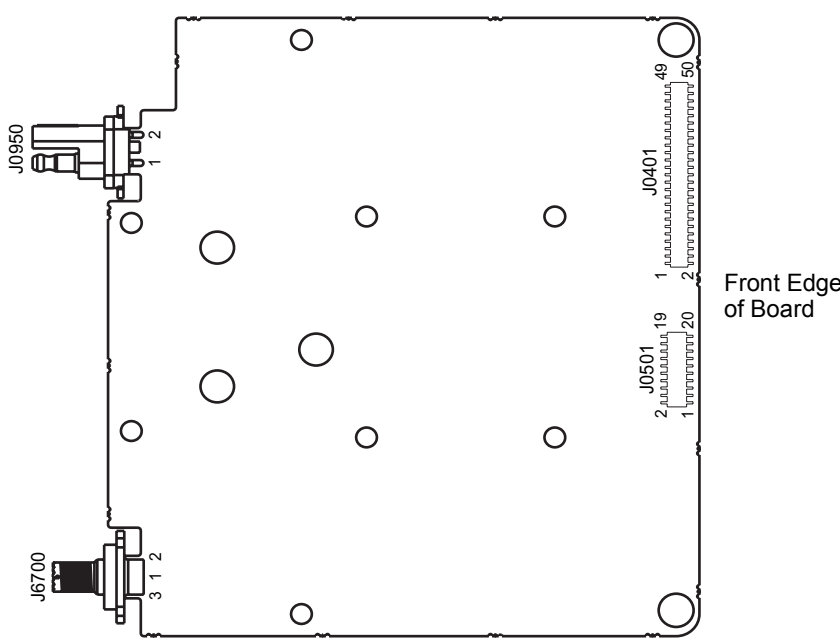


Figure 10-15. Main Board Connector Locations - Side 2 (Mid Power Only)

10.10.2High Power Only

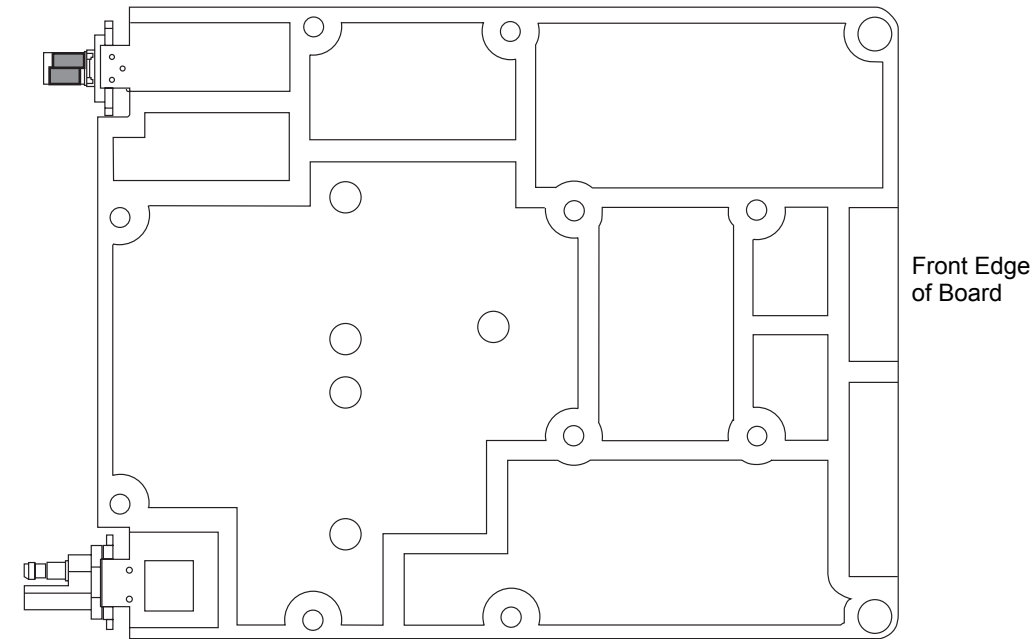


Figure 10-16. Main Board Connector Locations - Side 1 (High Power Only)

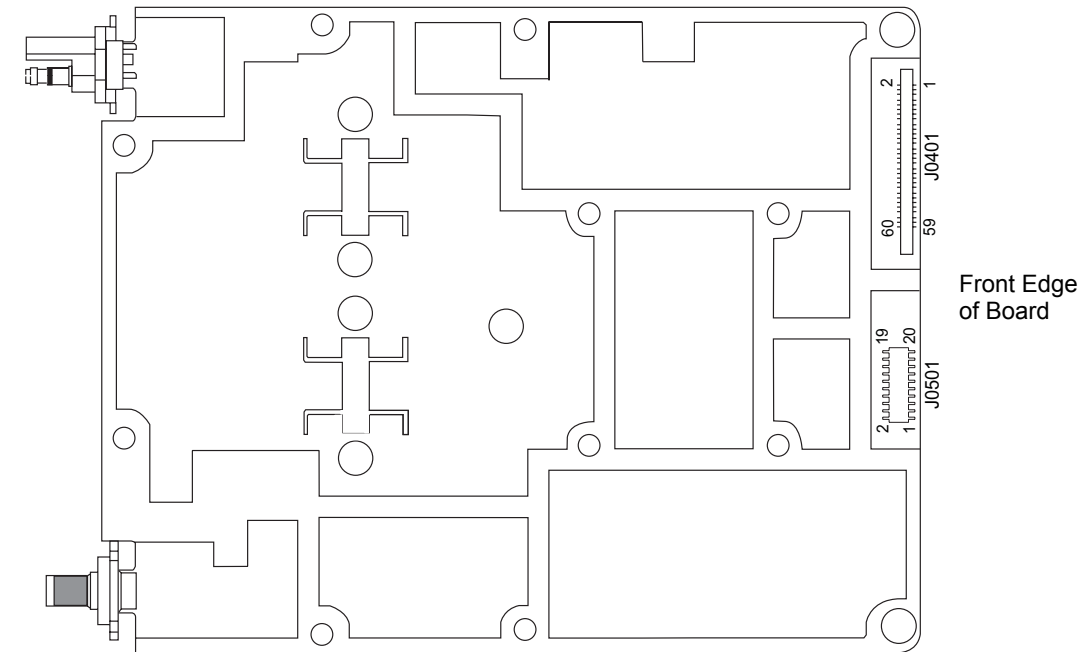


Figure 10-17. Main Board Connector Locations - Side 2 (High Power Only)

10.11 O5 Control Head Connectors

10.11.1For Mid Power Models

Figure 10-18 illustrates the pin arrangement and associated signals and voltages for the 50-pin control head connector.

pin # J0401-2	GND	pin # J0401-1	GND
pin # J0401-4	Mic In	pin # J0401-3	PTT
pin # J0401-6	Aux Mic	pin # J0401-5	RX_Filt_Audio
pin # J0401-8	Aux Rx	pin # J0401-7	Aux TX
pin # J0401-10	Spk-	pin # J0401-9	Spk+
pin # J0401-12	VIP OUT 2	pin # J0401-11	VIP OUT 1
pin # J0401-14	FPGA RESET	pin # J0401-13	FPGA Config
pin # J0401-16	FPGA Config Done	pin # J0401-15	FPGA Status
pin # J0401-18	EMERGENCY	pin # J0401-17	SW B+
pin # J0401-20	IGNITION	pin # J0401-19	A+
pin # J0401-22	OPTB+	pin # J0401-21	A+
pin # J0401-24	ONE WIRE	pin # J0401-23	VCC 5V
pin # J0401-26	Boot RX / USB(-)	pin # J0401-25	Boot TX / USB(+)
pin # J0401-28	DCE-RX	pin # J0401-27	DCE-TX
pin # J0401-30	DCE-CTS	pin # J0401-29	DCE-RTS
pin # J0401-32	Bus(-)	pin # J0401-31	Bus(+)
pin # J0401-34	LH_Reset	pin # J0401-33	LH_Busy
pin # J0401-36	SAP-RX	pin # J0401-35	SAP-TX
pin # J0401-38	SAP-Fsync	pin # J0401-37	SAP-Dclk
pin # J0401-40	FPGA-INT	pin # J0401-39	FPGA-CS
pin # J0401-42	SPI-misoB	pin # J0401-41	SPI-mosiB
pin # J0401-44	SPI-clk	pin # J0401-43	NOTCH
pin # J0401-46	BUS PWR OUT	pin # J0401-45	SSI_INT
pin # J0401-48	GCAI USB-RS232	pin # J0401-47	GCAI GPIO zero
pin # J0401-50	GND	pin # J0401-49	GND

Figure 10-18. Control Head 50-pin Connector

10.11.2For High Power Models

Figure 10-19 illustrates the pin arrangement and associated signals and voltages for the 60-pin control head connector.

pin # J0401-59	GND	pin # J0401-60	GND
pin # J0401-57	Mic Hi	pin # J0401-58	AUX PTT
pin # J0401-55	Aux Mic	pin # J0401-56	RX_Filt_Audio
pin # J0401-53	Aux Rx	pin # J0401-54	Aux TX
pin # J0401-51	Emergency	pin # J0401-52	GND
pin # J0401-49	FPGA Config Done	pin # J0401-50	FPGA Status
pin # J0401-47	FPGA RESET	pin # J0401-48	FPGA Config
pin # J0401-45	VIP OUT 2	pin # J0401-46	VIP OUT 1
pin # J0401-43	BUS_PWR_OUT	pin # J0401-44	Keyfail
pin # J0401-41	GPIO zero H.P.	pin # J0401-42	ONE_WIRE
pin # J0401-39	GCAI USB-RS232	pin # J0401-40	GCAI GPIO zero
pin # J0401-37	SPK+	pin # J0401-38	SPK+
pin # J0401-35	SPK-	pin # J0401-36	SPK-
pin # J0401-33	Sw B+	pin # J0401-34	Sw B+
pin # J0401-31	A+	pin # J0401-32	A+
pin # J0401-29	A+	pin # J0401-30	A+
pin # J0401-27	IGNITION	pin # J0401-28	IGNITION
pin # J0401-25	VCC 5V	pin # J0401-26	OPTB+
pin # J0401-23	GND	pin # J0401-24	VBUS USB_PWR
pin # J0401-21	Boot RX / USB(-)	pin # J0401-22	Boot TX / USB(+)
pin # J0401-19	DCE-RX	pin # J0401-20	DCE-TX
pin # J0401-17	DCE-CTS	pin # J0401-18	DCE-RTS
pin # J0401-15	Bus(-)	pin # J0401-16	Bus(+)
pin # J0401-13	LH_Reset	pin # J0401-14	LH_Busy
pin # J0401-11	SAP-RX	pin # J0401-12	SAP-TX
pin # J0401-9	SAP-Fsync	pin # J0401-10	SAP-Dclk
pin # J0401-7	FPGA-INT	pin # J0401-8	FPGA-CS
pin # J0401-5	SPI-misoB	pin # J0401-6	SPI-mosiB
pin # J0401-3	SSI_INT	pin # J0401-4	SPI-clk
pin # J0401-1	GND	pin # J0401-2	GND

Figure 10-19. Control Head 60-pin Connector

Notes

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# Chapter 11 Exploded Views and Parts Lists

This chapter contains the exploded views and associated parts lists for the ASTRO XTL 5000 digital mobile radio and accessories. Tables containing pushbutton parts lists are also included at the end of this chapter.

Table 11-1. Table of Exploded Views

Page	Figure Name
11-2	<a href="#">Figure 11-1. XTL 5000 O3 Control Head Exploded View</a>
11-3	<a href="#">Figure 11-2. XTL 5000 O5 Control Head Exploded View</a>
11-4	<a href="#">Figure 11-3. CHIB and CHUC Exploded View</a>
11-5	<a href="#">Figure 11-4. Transceiver Interface Board (TIB) Exploded View</a>
11-6	<a href="#">Figure 11-5. XTL 5000 O3 Radio Exploded View</a>
11-7	<a href="#">Figure 11-6. XTL 5000 O5 Dash Mount Radio Exploded View</a>
11-8	<a href="#">Figure 11-7. XTL 5000 O5 Mid Power Remote Mount Radio Exploded View</a>
11-9	<a href="#">Figure 11-8. XTL 5000 100 W Remote Mount Radio Exploded View</a>



11.1 XTL 5000 O3 Control Head Exploded View

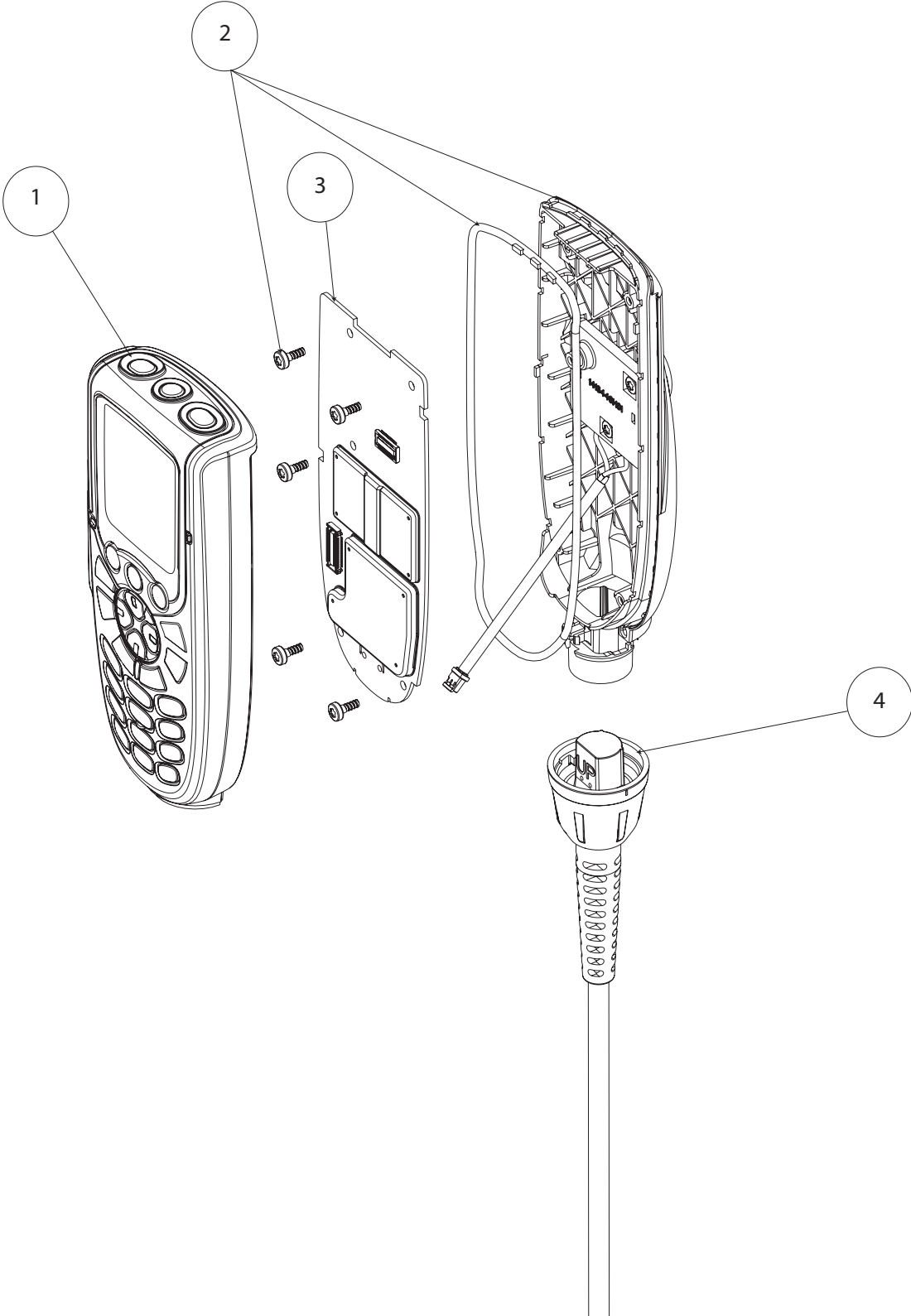


Figure 11-1. XTL 5000 O3 Control Head Exploded View

Table 11-2. XTL 5000 O3 Control Head Parts List

Item No.	Quantity	Motorola Part No.	Description
1	1	PMHN4082_	Housing, Front, Service Kit
2	1	PMHN4083_	Housing, Back, Service Kit (includes O-ring [qty. 1] and screws, 0310944A02 [qty. 5])
3	1	PMLN5035_	PCB Service Kit
4	1	PMLN4961_	Cable, Coiled, Kit

**Note:**    \_ = The latest version kit. When ordering, refer to your specific kit for this suffix letter.

11.2 XTL 5000 O5 Control Head Exploded View

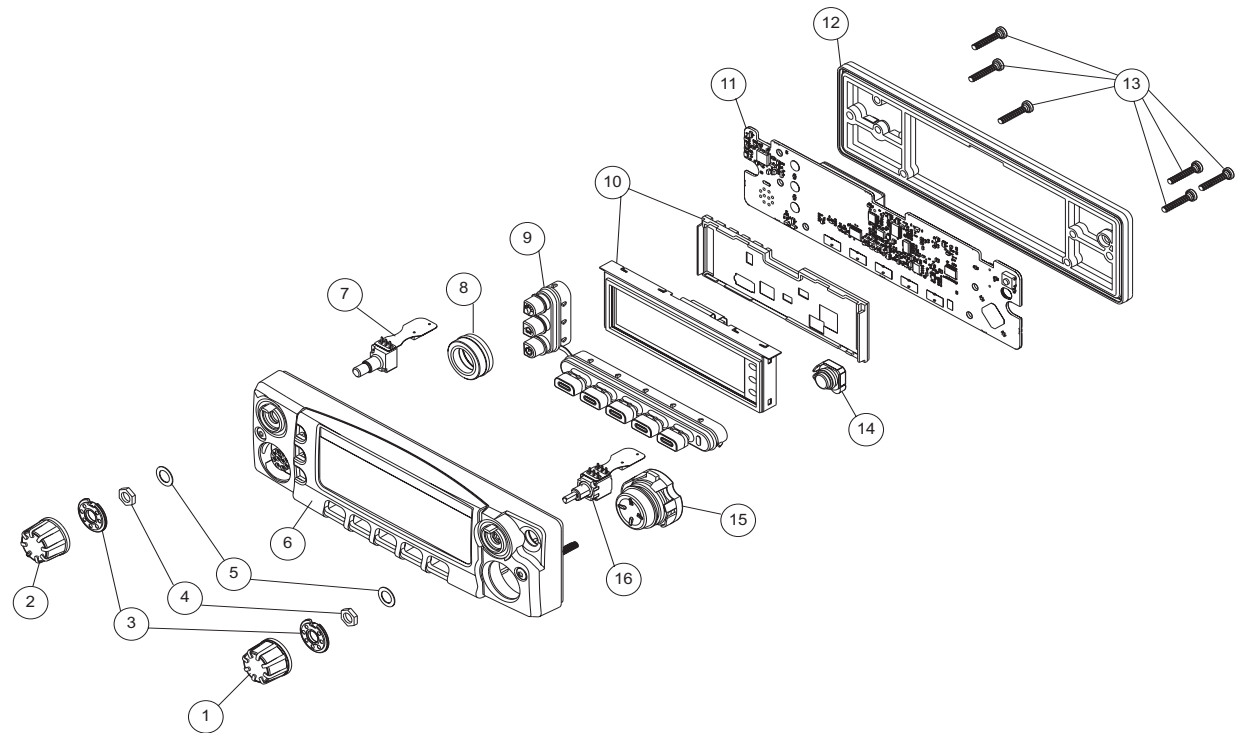


Figure 11-2. XTL 5000 O5 Control Head Exploded View

Table 11-3. XTL 5000 O5 Control Head Parts List

Item No.	Quantity	Motorola Part No.	Description
1	1	3664445H01	KNOB, Mode
2	1	3664022H01	KNOB, Volume
3	2	0415285H01	WASHER, Torque
4	2	0215000C01	NUT, Hex, Special
5	2	0402838X01	WASHER, 3 Wave
6	1	1564047H02	HOUSING, Front Assembly (Includes Light pipe, Vol/Select, 6164056H02, [qty 2])
7	1	1864069H01	POTENTIOMETER, Volume Assembly
8	1	3264133H01	SEAL, O-Ring, GCAI
9	1	3864503H04	BUTTONS, Main Assembly
10	1	7264052H03	DISPLAY, LC (Includes Shield LCD, 2675960A01)
11	1	HLN6911_	PCB, Control Head Main
12	1	3264059H02	SEAL, Overmolded Frame
13	6	0310944A14	SCREWS, Mounting
14	1	3864502H04	BUTTON, Emergency
15	1	3864499H02	BUTTON, Navigation, Assembly
16	1	4064073H01	SWITCH, Freq. Assembly

11.3 CHIB & CHUC Exploded View

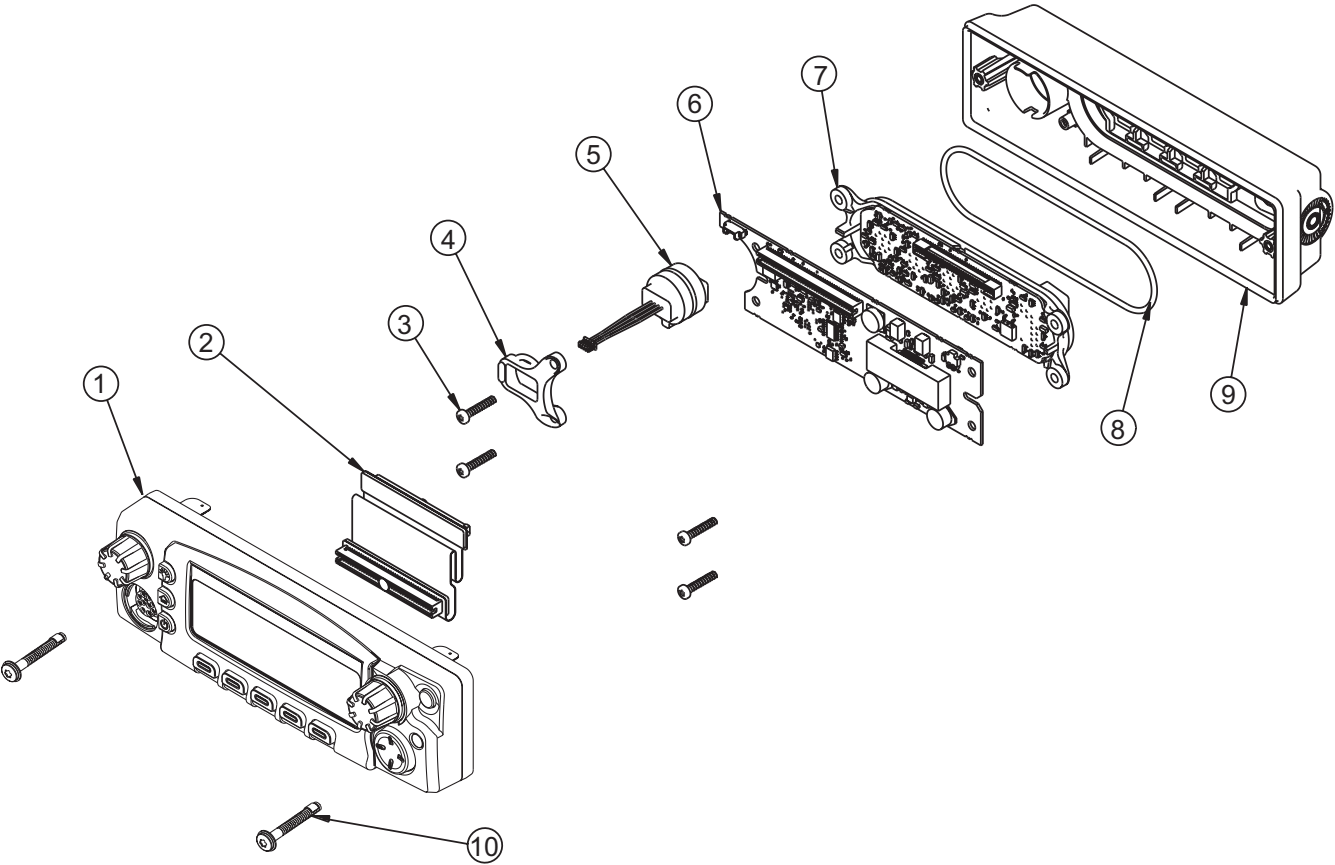


Figure 11-3. CHIB and CHUC Exploded View

Table 11-4. CHIB and CHUC Parts List

Item No.	Motorola Part No.	Description
1	HLN1467_	Control Head
2	HKN6191_	Flex Assembly
3	0310944A14	Screw
4	0764091H01	Retainer Bracket
5	0964098H01	USB Adapter
6	HLN6912_	CHIB
7	HLN6914_	CHUC
8	3264096H01	Moisture Seal
9	1564090H01	Rear Housing
10	0364332H02	Main Screws
Not shown	HLN6954_	Kit, Dust Cover

11.4 Transceiver Interface Board (TIB) Exploded View

This illustration (Figure 11-4) represents the interface board for all remote mount configurations, for both mid power and high power transceivers (only the flex changes depending on mid power or high power transceiver).

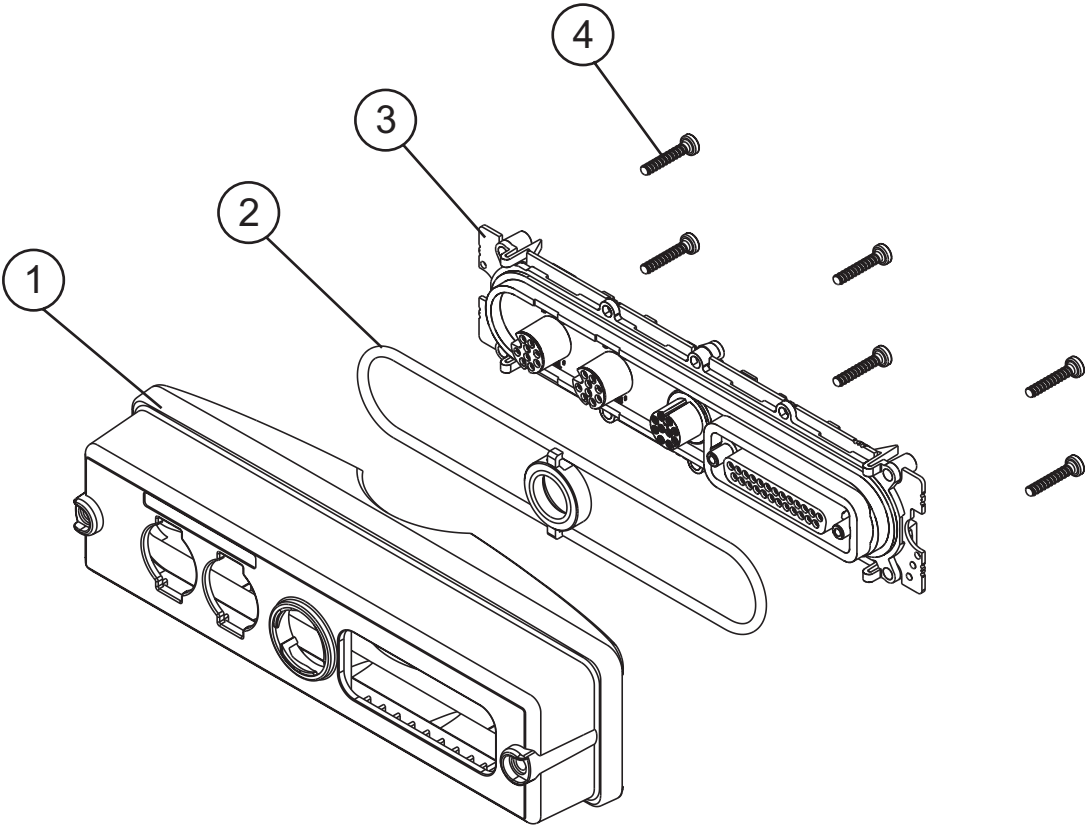


Figure 11-4. Transceiver Interface Board (TIB) Exploded View

Table 11-5. Transceiver Interface Board (TIB) Parts List

Item No.	Motorola Part No.	Description
1	1564119H01	Housing, Remote Front
2	3264121H01	Seal, Moisture, Silicone
3	PMLN5038_ HLN6895_ HLN6913_	TIB Board Assembly
4	0310944A14	Screw, Tapping (6)
*	3364474H01	Label, Housing (On Housing)
*	HLN6954_	Kit, Dust Cover (Not shown)

Note: \_ = The latest version kit. When ordering, refer to your specific kit for this suffix letter.

11.5 XTL 5000 O3 Radio Exploded View

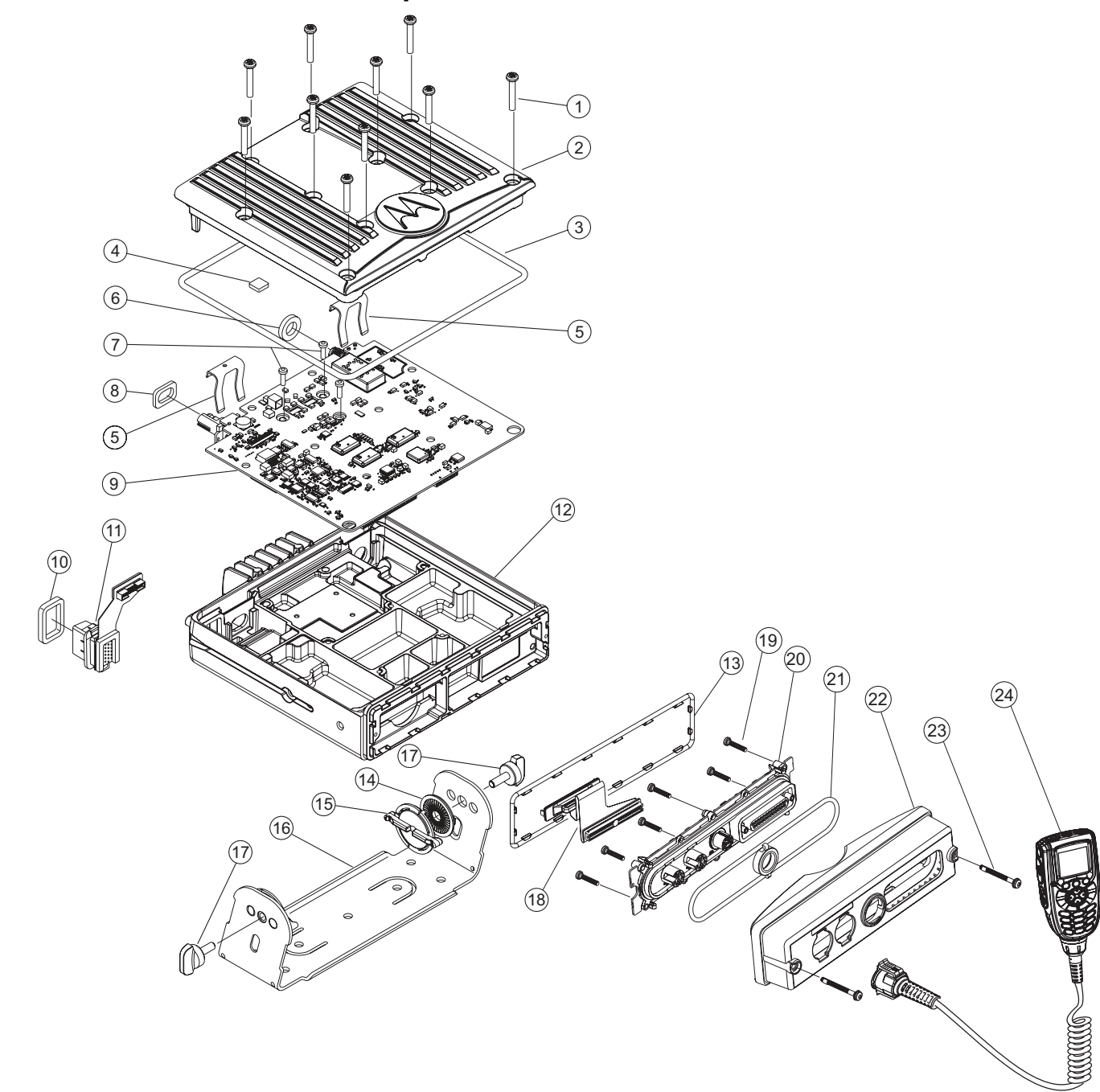


Figure 11-5. XTL 5000 O3 Radio Exploded View

Table 11-6. XTL 5000 Dash Mount Radio Parts List

Item No.	Motorola Part No.	Description
1	0385870E01	SCREW ASSEMBLY, TOP COVER
2	1585860C02	COVER, XTL 5000
3	3285495E01	SEAL, MAIN O-RING
4	7585060F01	PAD, THERMAL, GREY
5	4285702E01	CLIP, RF/DC RETENTION
6	3285743E01	SEAL, RF CONNECTOR
7	0310907A20	SCREW, M3X0.5X10 PAN-HEAD
8	3285744E01	SEAL, DC CONNECTOR
9	HUD4022_ HUE4039_ HUE4040_ HUF4017_	PCB ASSEMBLY, VHF, MAIN* PCB ASSEMBLY UHF RANGE 1, MAIN* PCB ASSEMBLY, UHF RANGE 2, MAIN* PCB ASSEMBLY, 700-800 MHZ, MAIN*
10	3285742E01	SEAL, ACCESSORY
11	3085741E01	CONNECTOR, REAR ACCESSORY PORT
12	2785862C02	CHASSIS, XTL 5000 (See Table 8-2, "Chassis Thermal Pad Parts," on page 8-41 for thermal pad part numbers.)
13	3285471E01	SEAL, HEADBRIDGE
14	4305425W01	SPACER, INNER
15	4305426W03	SPACER, OUTER
16	HLN6861_	TRUNNION, XTL 5000 INCLUDES 18 (x2), 19 (x2), AND 21 (x2)
17	0305760W02	SCREW, M5.0X0.8X14.9 WING
18	HKN6192_	FLEX
19	0310944A14	SCREW, TAPPING (6)
20	PMLN5038_ HLN6895_ HLN6913_	TIB BOARD ASSEMBLY
21	3264121H01	SEAL, MOISTURE, SILICONE
22	1564119H01	HOUSING, REMOTE FRONT
23	0364332H02	MAIN SCREWS
24	-	O3 CONTROL HEAD

**Note:** The underscore ( \_ ) used at the end of the kit number is replaced with the kit revision letter. When ordering, refer to your specific kit for this suffix letter.  
(\*) includes items 6 and 8

11.6 XTL 5000 O5 Dash Mount Radio Exploded View

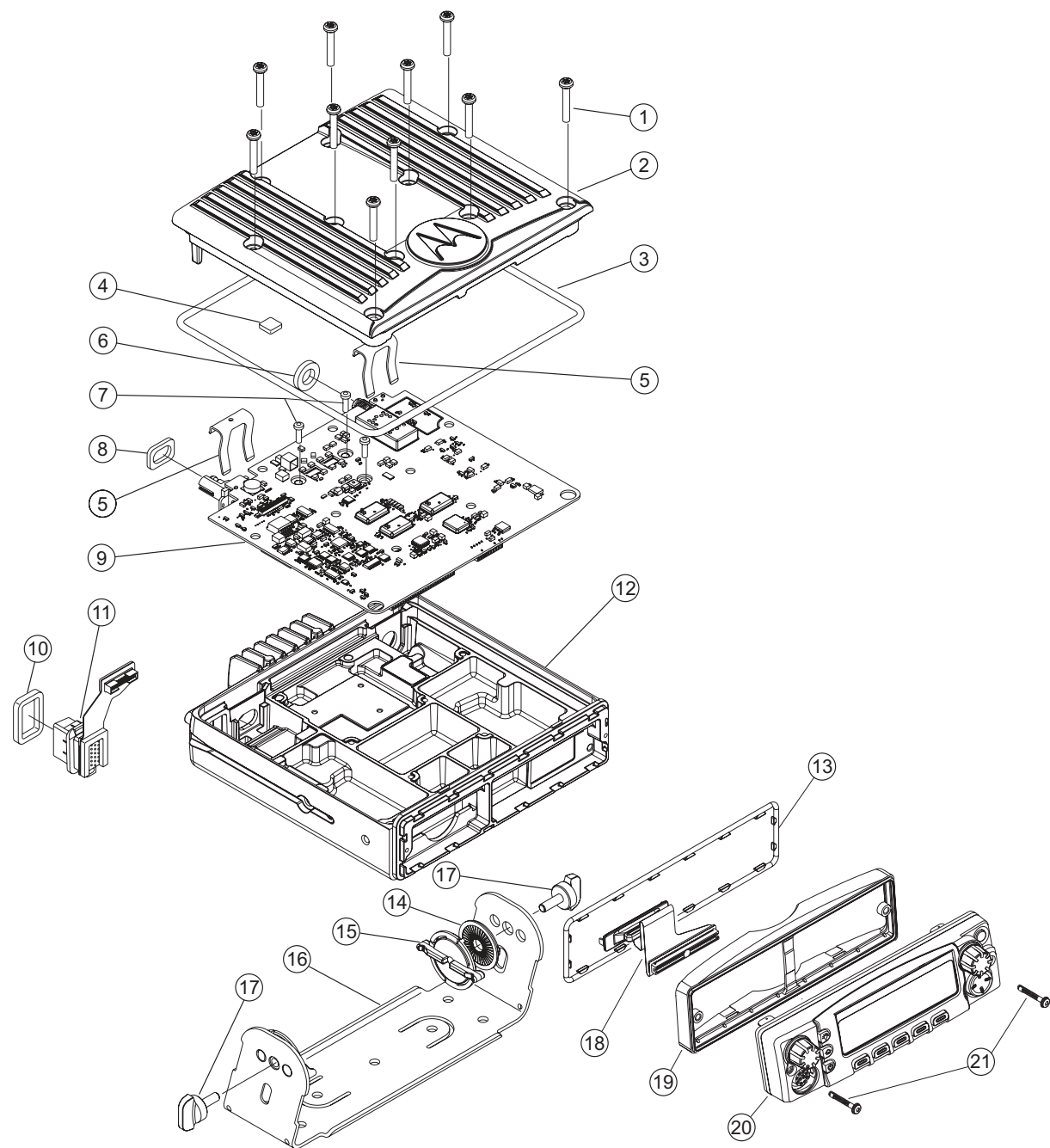


Figure 11-6. XTL 5000 O5 Dash Mount Radio Exploded View

Table 11-7. XTL 5000 Dash Mount Radio Parts List

Item No.	Motorola Part No.	Description
1	0385870E01	SCREW ASSEMBLY, TOP COVER
2	1585860C02	COVER, XTL 5000
3	3285495E01	SEAL, MAIN O-RING
4	7585060F01	PAD, THERMAL, GREY
5	4285702E01	CLIP, RF/DC RETENTION
6	3285743E01	SEAL, RF CONNECTOR
7	0310907A20	SCREW, M3X0.5X10 PAN-HEAD
8	3285744E01	SEAL, DC CONNECTOR
9	HUD4022_ HUE4039_ HUE4040_ HUF4017_	PCB ASSEMBLY, VHF, MAIN* PCB ASSEMBLY UHF RANGE 1, MAIN* PCB ASSEMBLY, UHF RANGE 2, MAIN* PCB ASSEMBLY, 700-800 MHZ, MAIN*
10	3285742E01	SEAL, ACCESSORY
11	3085741E01	CONNECTOR, REAR ACCESSORY PORT
12	2785862C02	CHASSIS, XTL 5000 (See Table 8-2, "Chassis Thermal Pad Parts," on page 8-41 for thermal pad part numbers.)
13	3285471E01	SEAL, HEADBRIDGE
14	4305425W01	SPACER, INNER
15	4305426W03	SPACER, OUTER
16	HLN6861_	TRUNNION, XTL 5000 INCLUDES 18 (x2), 19 (x2), AND 21 (x2)
17	0305760W02	SCREW, M5.0X0.8X14.9 WING
18	HKN6192_	FLEX
19	1585245E02	HEADBRIDGE
20	HLN1467_	FRONT HOUSING KIT
21	0364332H02	MAIN SCREWS

**Note:** The underscore ( \_ ) used at the end of the kit number is replaced with the kit revision letter. When ordering, refer to your specific kit for this suffix letter.  
(\*) includes items 6 and 8



11.7 XTL 5000 O5 Mid-Power Remote Mount Radio Exploded View

Table 11-8. XTL 5000 Mid Power Remote Mount Radio Parts List

Item No.	Motorola Part No.	Description
1	0364332H02	FRONT HOUSING SCREW ASSEMBLY
2	PMUN1036_ HLN1454_ HLN1472_	REMOTE ASSEMBLY, RADIO
3	HKN6190_	FLEX, MID-POWER
4	3285471E01	SEAL, HEADBRIDGE

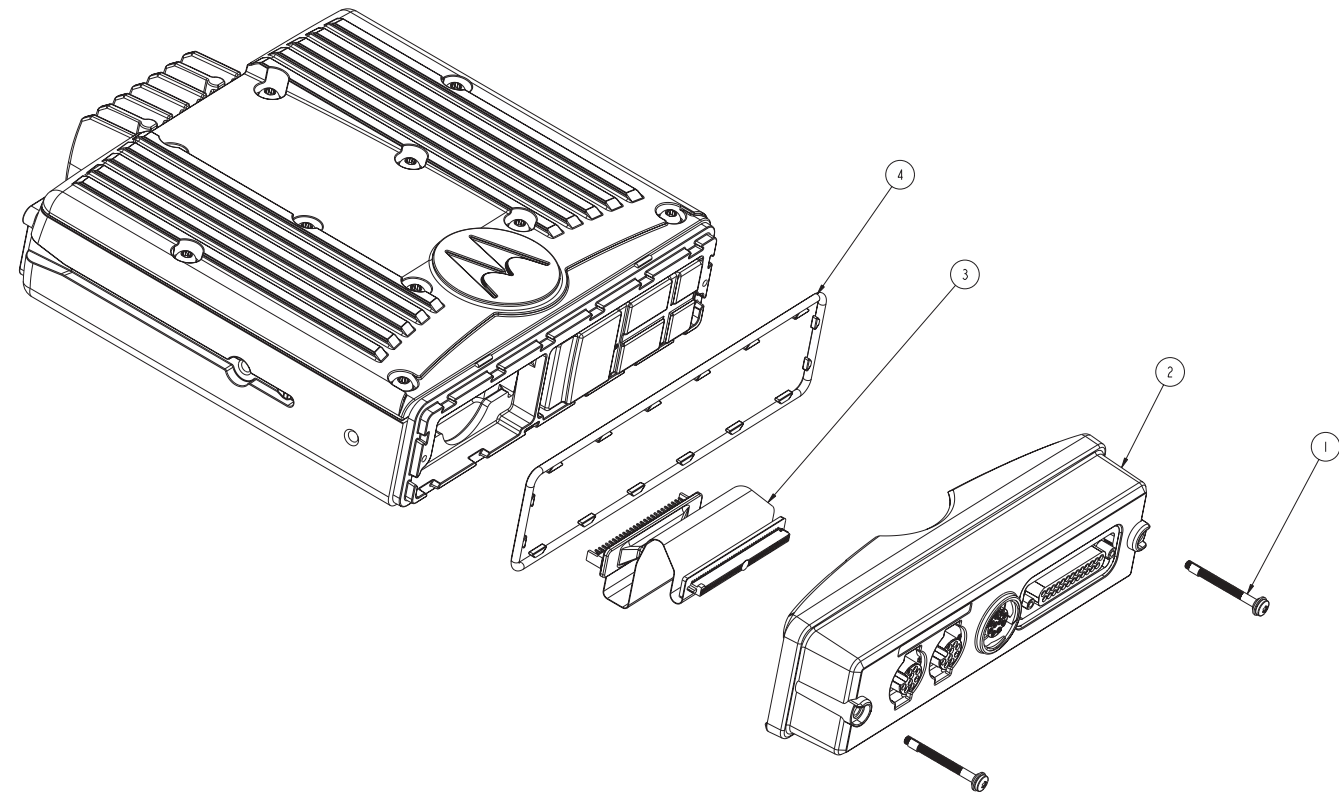


Figure 11-7. XTL 5000 O5 Mid Power Remote Mount Radio Exploded View

11.8 XTL 5000 100 W Remote Mount Radio Exploded View

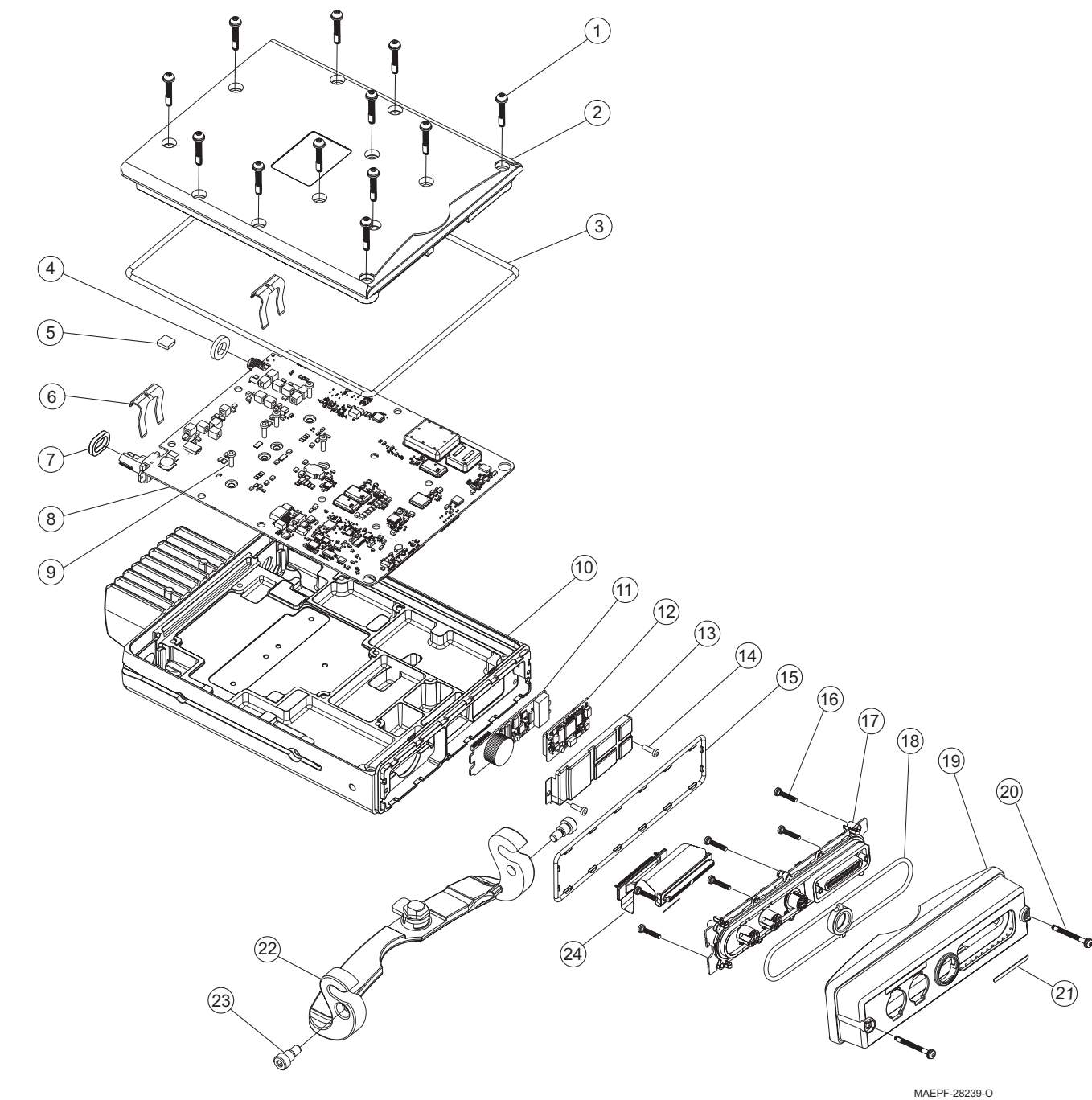


Figure 11-8. XTL 5000 100 W Remote Mount Radio Exploded View

Table 11-9. XTL 5000 100 W Remote Mount Radio Parts List

Item No.	Motorola Part No.	Description
1	0385870E01	SCREW ASSEMBLY, BOTTOM COVER
2	1564414H02	COVER, XTL 5000 HIGH POWER
3	3285995F01	SEAL, MAIN O-RING
4	3285743E01	SEAL, RF CONNECTOR
5	7585060F01	PAD, THERMAL GREY
6	4285702E01	CLIP, RF/DC RETENTION
7	3285744E01	SEAL, DC CONNECTOR
8	HUD4025_ HUE4043_	PCB ASSEMBLY, VHF, MAIN* PCB ASSEMBLY, UHF RANGE 1, MAIN*
9	0310907A20	SCREW, M3X0.5X10, PAN-HEAD (Used to hold down secure shield and main board kit)
10	2764415H02	CHASSIS, XTL 5000 High Power (See Table 8-3, "Chassis Thermal Pad Parts," on page 8-43 for thermal pad part numbers.)
11	HLN6876_ or HLN6877_	PCB ASSEMBLY, SECURE INTERFACE (3-DAY KEY RETENTION) or PCB ASSEMBLY, SECURE INTERFACE (30- SECOND KEY RETENTION)
12	-----	MODULE, SECURE
13	2685498E01	SHIELD, SECURE
14	0310907A20	SCREW, M3X0.5X10, PAN-HEAD (Used to hold down secure shield and main board kit)
15	3285471E01	SEAL, HEADBRIDGE
16	0310944A14	SCREW, REMOTE INTERFACE BOARD TO FRONT HOUSING
17	PMLN5038_ HLN6895_ HLN6913_	REMOTE INTERFACE BOARD FOR XTL 5000 CONTROL HEAD
18	3264121H01	REMOTE INTERCONNECT BOARD SEAL
19	1564119H01	REMOTE INTERCONNECT FRONT HOUSING
20	0364332H02	REMOTE FRONT HOUSING SCREW ASSY (with seal)
21	3364474H01	FRONT HOUSING LABEL FOR XTL 5000 CONTROL HEAD
22	5564610H02	QUICK RELEASE HANDLE/LOCK ASSEMBLY
23	0364583H01	QUICK RELEASE HANDLE SHOULDER BOLTS
24	3064658H01	REMOTE INTERFACE ASSEMBLY FLEX CIRCUIT
25	5564957H01	LOCK KEY (Not Shown)
26	HLN6909_	TRUNNION KIT, QUICK RELEASE (Not Shown)

**Note:** The underscore ( \_ ) used at the end of the kit number is replaced with the kit revision letter. When ordering, refer to your specific kit for this suffix letter.  
(\*) Includes items 4 and 7.



Notes

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## Appendix A Replacement Parts Ordering

### A.1 Basic Ordering Information

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

Crystal orders should specify the crystal type number, crystal and carrier frequency, and the model number in which the part is used.

### A.2 Motorola Online

Motorola Online users can access our online catalog at

<https://www.motorola.com/businessonline>

To register for online access, please call 800-814-0601 (for U.S. and Canada Service Centers only). International customers can obtain assistance at <https://businessonline.motorola.com>.

### A.3 Mail Orders

Send written orders to the following addresses:

**Replacement Parts/  
Test Equipment/Manuals/  
Crystal Service Items:**

Motorola Inc.  
Radio Products Services Division\*  
Attention: Order Processing  
1307 E. Algonquin Road  
Schaumburg, IL 60196  
U.S.A.

**Federal Government Orders:**

Motorola Inc.  
U.S. Federal Government  
Markets Division  
Attention: Order Processing  
7230 Parkway Drive  
Landover, MD 21076  
U.S.A.

**International Orders:**

Motorola Inc.  
Radio Products Services Division\*  
Attention: Order Processing  
1307 E. Algonquin Road  
Schaumburg, IL 60196  
U.S.A.

\* The Radio Products Services Division (RPSD) was formerly known as the Customer Care and Services Division (CCSD) and/or the Accessories and Aftermarket Division (AAD).

### A.4 Telephone Orders

Radio Products Services Division\*  
(United States and Canada)  
7:00 AM to 7:00 PM (Central Standard Time)  
Monday through Friday (Chicago, U.S.A.)  
1-800-422-4210  
1-847-538-8023 (International Orders)

U.S. Federal Government Markets Division (USFGMD)  
1-800-826-1913 Federal Government Parts - Credit Cards Only  
8:30 AM to 5:00 PM (Eastern Standard Time)

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## **A.5 Fax Orders**

Radio Products Services Division\*  
(United States and Canada)  
1-800-622-6210  
847-576-3023 (International)

USFGMD  
(Federal Government Orders)  
1-800-526-8641 (For Parts and Equipment Purchase Orders)

## **A.6 Parts Identification**

Radio Products Services Division\*  
(United States and Canada)  
1-800-422-4210, menu 3

## **A.7 Product Customer Service**

Customer Response Center  
(Non-technical Issues)  
1-800-247-2346  
FAX:1-800-247-2347

\* The Radio Products Services Division (RPSD) was formerly known as the Customer Care and Services Division (CCSD) and/or the Accessories and Aftermarket Division (AAD).

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## Appendix B   Environmental Information

The ASTRO Digital XTL 5000 mobile radio control head and transceiver was designed using Design for Environment (DfE) principles.

- Motorola has used halogen-reduced printed circuit board material in the production of this product.
- Motorola has used No-lead solder in the production of this product.
- There are no embedded batteries in this product.
- Motorola encourages reuse or recycling of the material used to manufacture this product. Please contact Motorola at 1-888-567-7347 or your local sales representative for rebate programs and for the latest disassembly and recycling strategies.
- Please do not dispose of this product into a landfill.

## Notes

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# Glossary

This glossary contains an alphabetical listing of terms and their definitions that are applicable to ASTRO portable and mobile subscriber radio products. All terms do not necessarily apply to all radios, and some terms are merely generic in nature.

Term	Definition
<b>A/D</b>	<i>See analog-to-digital conversion.</i>
<b>ADC</b>	<i>See analog-to-digital converter.</i>
<b>ALC</b>	<i>See automatic level control.</i>
<b>analog</b>	Refers to a continuously variable signal or a circuit or device designed to handle such signals. <i>See also digital.</i>
<b>analog-to-digital conversion</b>	Conversion of an instantaneous dc voltage level to a corresponding digital value. <i>See also D/A.</i>
<b>analog-to-digital converter</b>	A device that converts analog signals into digital data. <i>See also DAC.</i>
<b>APCO 25</b>	A standard of digital two-way radio communications, developed by the Association of Public-Safety Communications Officials, providing maximum radio spectrum efficiency; competition in system life cycle procurements; effective, efficient and reliable intra-agency and inter-agency communications; and “user friendly” equipment. <i>See also Association of Public-Safety Communications Officials.</i>
<b>Association of Public-Safety Communications Officials</b>	An association dedicated to an industry-wide effort (known as APCO 25 or Project 25) to set the recommended voluntary standards of uniform digital two-way radio technology for public safety organizations. This allows radio interoperability with multiple vendor products which are all APCO 25 compatible. <i>See also APCO 25.</i>
<b>automatic level control</b>	A circuit in the transmit RF path that controls RF power amplifier output, provides leveling over frequency and voltage, and protects against high VSWR.
<b>band</b>	Frequencies allowed for a specific purpose.
<b>BBP</b>	<i>See baseband interface port.</i>
<b>baseband interface port</b>	Synchronous serial interface to the transceiver board used to transfer transmit and receive audio data.
<b>BGA</b>	<i>See ball grid array.</i>

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Term	Definition
<b>ball grid array</b>	A type of IC package characterized by solder balls arranged in a grid that are located on the underside of the package.
<b>CAN</b>	Controller Area Network protocol. The CAN cable is the remote communications cable which provides audio, data, and power signaling information between the Control head and the Transceiver.
<b>CHIB</b>	Control Head Interface Board. Used to provide functionality / connectivity between the CHUC and control head.
<b>CHUC</b>	Control Head Universal Connector. A separate board which provides connectivity to the CHIB and control head.
<b>CODEC</b>	<i>See coder/decoder.</i>
<b>coder/decoder</b>	A device that encodes or decodes a signal.
<b>CPS</b>	<i>See Customer Programming Software.</i>
<b>Customer Programming Software</b>	Software with a graphical user interface containing the feature set of an ASTRO radio.
<b>C4FM</b>	<i>See Constant Envelope 4-Level Frequency Modulation.</i>
<b>Constant Envelope 4-Level Frequency Modulation</b>	Also referred to as a 4-carrier modulation format where the carrier is shifted in frequency at a particular rate (time) to a particular location around a center frequency. This allows for each of the 4 "states" to represent a binary number. Each state is a "DiBit" or "Symbol" which contains two bits of information
<b>D/A</b>	<i>See digital-to-analog conversion.</i>
<b>DAC</b>	<i>See digital-to-analog converter.</i>
<b>Data communication equipment</b>	Definition for device (such as radio) data communications using the RS232 protocol. The correct data communication wiring requires the device's TX pins (output) to connect to the RX pins (input) and the RTS pins (output) to connect to the CTS pins (input). It is incorrect to attach device pins having the same name to each other.
<b>Data terminal equipment</b>	Data terminal equipment; for example, a computer.
<b>DCE</b>	<i>See Data communication equipment.</i>
<b>default</b>	A pre-defined set of parameters.
<b>digital</b>	Refers to data that is stored or transmitted as a sequence of discrete symbols from a finite set; most commonly this means binary data represented using electronic or electromagnetic signals. <i>See also analog.</i>

Term	Definition
<b>digital-to-analog conversion</b>	Conversion of a digital signal to a voltage that is proportional to the input value. <i>See also A/D.</i>
<b>digital-to-analog converter</b>	A device that converts digital data into analog signals. <i>See also ADC.</i>
<b>Digital Private-Line</b>	A type of digital communications that utilizes privacy call, as well as memory channel and busy channel lock out to enhance communication efficiency.
<b>digital signal processor</b>	A microcontroller specifically designed for performing the mathematics involved in manipulating analog information, such as sound, that has been converted into a digital form. DSP also implies the use of a data compression technique.
<b>digital signal processor code</b>	Object code executed by the Digital Signal Processor in an ASTRO subscriber radio. The DSP is responsible for computation-intensive tasks, such as decoding ASTRO signaling.
<b>DPL</b>	<i>See Digital Private-Line. See also PL.</i>
<b>DSP</b>	<i>See digital signal processor.</i>
<b>DSP code</b>	<i>See digital signal processor code.</i>
<b>DTE</b>	<i>See Data terminal equipment.</i>
<b>DTMF</b>	<i>See dual tone multi-frequency.</i>
<b>dual tone multi-frequency</b>	The system used by touch-tone telephones. DTMF assigns a specific frequency, or tone, to each key so that it can easily be identified by a microprocessor.
<b>EEPOT</b>	Electrically Programmable Digital Potentiometer.
<b>EEPROM</b>	<i>See Electrically Erasable Programmable Read-Only Memory.</i>
<b>Electrically Erasable Programmable Read-Only Memory</b>	A special type of PROM that can be erased by exposing it to an electrical charge. An EEPROM retains its contents even when the power is turned off.
<b>FCC</b>	Federal Communications Commission.
<b>firmware</b>	Code executed by an embedded processor such as the Host or DSP in a subscriber radio. This type of code is typically resident in non-volatile memory and as such is more difficult to change than code executed from RAM.
<b>FGU</b>	<i>See frequency generation unit.</i>
<b>flash</b>	A non-volatile memory device similar to an EEPROM. Flash memory can be erased and reprogrammed in blocks instead of one byte at a time.



Term	Definition
<b>FLASHcode</b>	A 13-digit code which uniquely identifies the System Software Package and Software Revenue Options that are enabled in a particular subscriber radio. FLASHcodes are only applicable for radios which are upgradeable through the FLASHport process.
<b>FLASHport</b>	A Motorola term that describes the ability of a radio to change memory. Every FLASHport radio contains a FLASHport EEPROM memory chip that can be software written and rewritten to, again and again.
<b>frequency</b>	Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).
<b>frequency generation unit</b>	This unit generates ultra-stable, low phase noise master clock and other derived synchronization clocks that are distributed throughout the communication network.
<b>FPGA</b>	Field Programmable Gate Array.
<b>GCAI</b>	Global Core Accessory Interface. Used to connect accessories and programming cables to the control head and the TIB.
<b>General-Purpose Input/Output</b>	Pins whose function is programmable.
<b>GPIO</b>	<i>See General-Purpose Input/Output.</i>
<b>host code</b>	Object code executed by the host processor in an ASTRO subscriber radio. The host is responsible for control-oriented tasks such as decoding and responding to user inputs.
<b>IC</b>	<i>See integrated circuit.</i>
<b>IF</b>	Intermediate Frequency.
<b>IMBE</b>	A sub-band, voice-encoding algorithm used in ASTRO digital voice.
<b>inbound signaling word</b>	Data transmitted on the control channel from a subscriber unit to the central control unit.
<b>integrated circuit</b>	An assembly of interconnected components on a small semiconductor chip, usually made of silicon. One chip can contain millions of microscopic components and perform many functions.
<b>ISW</b>	<i>See inbound signaling word.</i>
<b>key-variable loader</b>	A device used to load encryption keys into a radio.
<b>kHz</b>	<i>See kilohertz.</i>
<b>kilohertz</b>	One thousand cycles per second. Used especially as a radio-frequency unit.
<b>KVL</b>	<i>See key-variable loader.</i>

Term	Definition
<b>LCD</b>	<i>See liquid-crystal display.</i>
<b>LED</b>	<i>See light emitting diode.</i>
<b>light emitting diode</b>	An electronic device that lights up when electricity is passed through it.
<b>liquid-crystal display</b>	An LCD uses two sheets of polarizing material with a liquid-crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them.
<b>LO</b>	<i>See Local oscillator.</i>
<b>Local Oscillator</b>	Oscillator used in a super heterodyne receiver to down-convert a received signal to the intermediate frequency.
<b>low-speed handshake</b>	150-baud digital data sent to the radio during trunked operation while receiving audio.
<b>LSH</b>	<i>See low-speed handshake.</i>
<b>Master In Slave Out</b>	SPI data line from a peripheral to the MCU.
<b>Master Out Slave In</b>	SPI data line from the MCU to a peripheral.
<b>MCU</b>	<i>See microcontroller unit.</i>
<b>MDC</b>	Motorola Digital Communications.
<b>MDI</b>	MCU/DSP Interface internal to the microprocessor IC.
<b>MHz</b>	<i>See Megahertz.</i>
<b>Megahertz</b>	One million cycles per second. Used especially as a radio-frequency unit.
<b>microcontroller unit</b>	Also written as $\mu\text{C}$ . A microprocessor that contains RAM and ROM components, as well as communications and programming components and peripherals.
<b>MISO</b>	<i>See Master In Slave Out.</i>
<b>MOSI</b>	<i>See Master Out Slave In.</i>
<b>multiplexer</b>	An electronic device that combines several signals for transmission on some shared medium (e.g., a telephone wire).
<b>MUX</b>	<i>See multiplexer.</i>
<b>OMAP</b>	An ARM core microcontroller
<b>open architecture</b>	A controller configuration that utilizes a microprocessor with extended ROM, RAM, and EEPROM.
<b>oscillator</b>	An electronic device that produces alternating electric current and commonly employs tuned circuits and amplifying components.

Term	Definition
<b>OSW</b>	<i>See outbound signaling word.</i>
<b>OTAR</b>	<i>See over-the-air rekeying.</i>
<b>outbound signaling word</b>	Data transmitted on the control channel from the central controller to the subscriber unit.
<b>over-the-air rekeying</b>	Allows the dispatcher to remotely reprogram the encryption keys in the radio.
<b>PA</b>	Power amplifier.
<b>paging</b>	One-way communication that alerts the receiver to retrieve a message.
<b>PC Board</b>	Printed Circuit Board. Also referred to as a PCB.
<b>phase-locked loop</b>	A circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.
<b>PL</b>	<i>See private-line tone squelch.</i>
<b>PLL</b>	<i>See phase-locked loop.</i>
<b>PMR</b>	<i>See Publication Manual Revision</i>
<b>private-line tone squelch</b>	A continuous sub-audible tone that is transmitted along with the carrier. <i>See also DPL.</i>
<b>Programmable Read-Only Memory</b>	A memory chip on which data can be written only once. Once data has been written onto a PROM, it remains there forever.
<b>programming cable</b>	A cable that allows the CPS to communicate directly with the radio using RS232 or USB.
<b>Project 25</b>	<i>See APCO 25.</i>
<b>PROM</b>	<i>See Programmable Read-Only Memory.</i>
<b>PTT</b>	<i>See Push-to-Talk.</i>
<b>Publication Manual Revision</b>	A publication that provides supplemental information for its parent publication before it is revised and reissued.
<b>Push-to-Talk</b>	The switch or button usually located on the left side of the radio which, when pressed, causes the radio to transmit. When the PTT is released, the unit returns to receive operation.
<b>radio frequency</b>	The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).
<b>radio frequency power amplifier</b>	Amplifier having one or more active devices to amplify radio signals.
<b>RAM</b>	<i>See random access memory.</i>

Term	Definition
<b>random access memory</b>	A type of computer memory that can be accessed randomly; that is, any byte of memory can be accessed without touching the preceding bytes.
<b>read-only memory</b>	A type of computer memory on which data has been prerecorded. Once data has been written onto a ROM chip, it cannot be removed and can only be read.
<b>real-time clock</b>	A module that keeps track of elapsed time even when a computer is turned off.
<b>receiver</b>	Electronic device that amplifies RF signals. A receiver separates the audio signal from the RF carrier, amplifies it, and converts it back to the original sound waves.
<b>registers</b>	Short-term data-storage circuits within the microcontroller unit or programmable logic IC.
<b>repeater</b>	Remote transmit/receive facility that re-transmits received signals in order to improve communications range and coverage (conventional operation).
<b>repeater/talkaround</b>	A conventional radio feature that permits communication through a receive/transmit facility, which re-transmits received signals in order to improve communication range and coverage.
<b>RESET</b>	Reset line: an input to the microcontroller that restarts execution.
<b>RF</b>	<i>See radio frequency.</i>
<b>RF PA</b>	<i>See radio frequency power amplifier.</i>
<b>ROM</b>	<i>See read-only memory.</i>
<b>RPT/TA</b>	<i>See repeater/talkaround.</i>
<b>RS232</b>	A common interface standard for data communications equipment.
<b>RTC</b>	<i>See real-time clock.</i>
<b>RX</b>	Receive.
<b>RX DATA</b>	Recovered digital data line.
<b>SAP</b>	<i>See Serial Audio Port.</i>
<b>Serial Audio Port</b>	SSI to and from the CODEC used to transfer transmit and receive audio data.
<b>Serial Peripheral Interface</b>	A serial interface comprised of two data lines and a clock line. This interface is typically used to communicate with other modules and ICs in the radio.
<b>signal</b>	An electrically transmitted electromagnetic wave.

Term	Definition
<b>Signal Qualifier mode</b>	An operating mode in which the radio is muted, but still continues to analyze receive data to determine RX signal type.
<b>softpot</b>	<i>See software potentiometer.</i>
<b>software</b>	Computer programs, procedures, rules, documentation, and data pertaining to the operation of a system.
<b>software potentiometer</b>	A computer-adjustable electronic attenuator.
<b>spectrum</b>	Frequency range within which radiation has specific characteristics.
<b>SPI</b>	<i>See Serial Peripheral Interface.</i>
<b>squelch</b>	Muting of audio circuits when received signal levels fall below a pre-determined value. With carrier squelch, all channel activity that exceeds the radio's preset squelch level can be heard.
<b>SRAM</b>	<i>See static RAM.</i>
<b>SSI</b>	<i>See Synchronous Serial Interface.</i>
<b>Standby mode</b>	An operating mode in which the radio is muted but still continues to monitor data.
<b>static RAM</b>	A type of memory used for volatile, program/data memory that does not need to be refreshed.
<b>Synchronous Serial Interface</b>	DSP interface to peripherals that consists of a clock signal line, a frame synchronization signal line, and a data line.
<b>system central controllers</b>	Main control unit of the trunked dispatch system; handles ISW and OSW messages to and from subscriber units ( <i>See ISW and OSW</i> ).
<b>thin small-outline package</b>	A type of dynamic random-access memory (DRAM) package that is commonly used in memory applications.
<b>TIB</b>	Transceiver Interface Board. Provides connectivity between transceiver and the CAN cable. Also, interface for accessories when TIB is used on a highpower transceiver.
<b>time-out timer</b>	A timer that limits the length of a transmission.
<b>TOT</b>	<i>See time-out timer.</i>
<b>transceiver</b>	Transmitter-receiver. A device that both transmits and receives analog or digital signals. Also abbreviated as XCVR.
<b>transmitter</b>	Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.
<b>TSOP</b>	<i>See thin small-outline package.</i>
<b>TX</b>	Transmit.

---

Term	Definition
<b>UART</b>	<i>See Universal Asynchronous Receiver Transmitter.</i>
<b>UHF</b>	Ultra-High Frequency.
<b>Universal Asynchronous Receiver Transmitter</b>	A microchip with programming that controls a computer's interface to its attached serial devices.
<b>UCM</b>	Universal Crypto Module
<b>Universal Serial Bus</b>	An external bus standard that supports data transfer rates of 12 Mbps.
<b>USB</b>	<i>See Universal Serial Bus.</i>
<b>VCO</b>	<i>See voltage-controlled oscillator.</i>
<b>VHF</b>	Very-High Frequency.
<b>VIP</b>	Vehicle Interface Port.
<b>VOCON</b>	<i>See vocoder/controller.</i>
<b>vocoder</b>	An electronic device for synthesizing speech by implementing a compression algorithm particular to voice. <i>See also voice encoder.</i>
<b>vocoder/controller</b>	A PC board that contains an ASTRO radio's microcontroller, DSP, memory, audio and power functions, and interface support circuitry.
<b>voice encoder</b>	The DSP-based system for digitally processing analog signals, and includes the capabilities of performing voice compression algorithms or voice encoding. <i>See also vocoder.</i>
<b>voltage-controlled oscillator</b>	An oscillator in which the frequency of oscillation can be varied by changing a control voltage.

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